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PHYSICS ABSTRACTS

SECTION A

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SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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THE AMERICAN
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VOLUME 53 SEPTEMBER 1950 NUMBER 633

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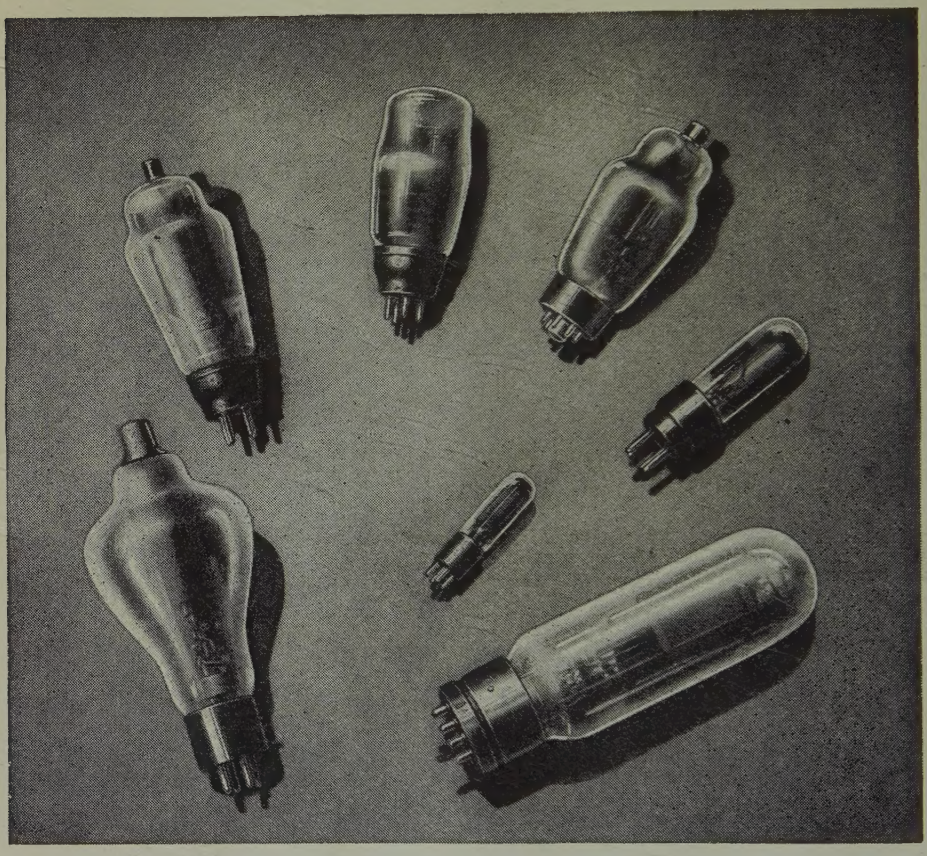

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SEPTEMBER 1950

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Thermionic tubes
Cathode-ray tubes
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Amplifiers
Radiocommunication
Mechanical engineering
Illumination
Metallurgy

LIST OF JOURNALS

The following list supplements that published with the January Number of Vol. 53 (1950). Journals marked * are not received regularly though abstracts of articles from them are occasionally published. The addresses given are believed to be correct, but no responsibility can be accepted for errors.

**Arch. Math.*	*Archiv der Mathematik.* [Abstracted by *Mathematical Reviews.*]
Circ. Univ. Ill. Engng Exp. Sta.	*Circulars of the University of Illinois Engineering Experiment Station.* University of Illinois, Urbana, Illinois.
**Concr. Constr. Engng.*	*Concrete and Construction Engineering.* [Abstracted by *Railway Engineering Abstracts.*]
Elektrotechniker	*Der Elecktrotechniker.* VDE-Verlag, Wuppertal-Elberfeld.
**J. Math. Pures Appl.*	*Journal de Mathématiques Pures et Appliquées.* [Abstracted by *Mathematical Reviews.*]
**Monogr. Sci. Aero.*	*Monografie Scientifiche di Aeronautica.* [Abstracted by *Index Aeronauticus.*]
**Nat. Peking Univ. Semi-Cent. Vol., Math. Phys. Biol. Ser.*	*The National Peking University Semi-Centennial Volume, Mathematical, Physical and Biological Series.* The University Press, National Peking University, Peking.
**Nova Acta Reg. Soc. Sci. Upsaliensis.*	*Nova Acta Regiae Societatis Scientiarum Upsaliensis.* Meteorologiska Institutionen vid Kungl. Universitetet. Uppsala.
**Proc. Amer. Soc. Test. Mater.*	*Proceedings of the American Society for Testing Materials.* [Abstracted by Metropolitan-Vickers Electrical Company.]
Proc. Egyptian Acad. Sci.	*Proceedings of the Egyptian Academy of Sciences.* "Dar el Hikma," 42, Qasr el Aini Street, Cairo.
Progr. Theor. Phys.	*Progress of Theoretical Physics.* Progress of Theoretical Physics Publishing Society, Department of Physics, Kyoto University, Kyoto. [Change of address.]
Publ. Astr. Soc. Japan.	*Publications of the Astronomical Society of Japan.* Tokyo Astronomical Observatory, Mitaka, Tokyo.
**S.B. Math. Nat. Kl. Bayer. Akad. Wiss.*	*Sitzungsberichte der Mathematisch-Naturwissenschaftlichen Klasse der Bayerischen Akademie der Wissenschaften zu München.* [Abstracted by *Mathematical Reviews.*]
Sci. Rep. Res. Inst. Tôhoku Univ. Ser. A.	*Science Reports of the Research Institutes, Tôhoku University, Series A (Physics, Chemistry and Metallurgy).* Tohoku University, Sendai.
Tech. Mitt. PTT, Bern	*Technische Mitteilungen.* Die Schweizerische Post-, Telegraphen- und Telephonverwaltung, Speichergasse 6, Bern. [Alteration to entry in Journals List of January (1950).]
**Univ. Nac. Tucumán, Publ.*	*Universidad Nacional de Tucumán, Publicación.* Instituto de Fisica, Universidad Nacional de Tucumán, Argentina.

ORIGINAL ARTICLES

It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the January Number of Vol. 53 (1950), or in the supplementary lists published subsequently.

ERRATA

Page 498, column 2, line 33: *for Abstr.* 4547 *read Abstr.* 4577.
Abstr. 1027, line 2: *for* A. I. Alikhanian *read* A. I. Alikhanyan.
line 3: *for* M. I. Deĭon *read* M. I. Daĭon.
Abstr. 1053, line 3: *for* T. N. Charkhchyan *read* T. N. Charakhchyan.
Abstr. 1061, line 3: *for* S. Nikolsky *read* S. Nikolskiĭ.
line 4: *for* V. Tsirlin *read* V. Tsyrlin.
Abstr. 1843, line 3: *for* Y. Yamamuchi *read* Y. Yamaguchi.
Abstr. 2217, line 2: *for* M. G. Viguier *read* G. Viguier.
Abstr. 2457, line 3: *for* T. Z. Fisher *read* I. Z. Fisher.
Abstr. 2986, line 2: *for* L. D. Rosenberg *read* L. D. Rozenberg.
Abstr. 3273, line 2: *for* N. Z. Miriazov *read* N. Z. Miryasov.
Abstr. 3598, line 3: *for* S. F. Radionov *read* S. F. Rodionov.
Abstr. 4305, line 2: *for* H. C. Price *read* H. C. Price, Jr.
Abstr. 4805, 4915, 4953, 4976, 4990, 5366, 6150, journal reference:
for Proc. Phys. Soc., Lond. A read
Proc. Phys. Soc., Lond. B.
Abstr. 4878, line 5: *for* H. F. *read* HF.
Abstr. 5025, line 2: *for* E. Schoppert *read* E. Schopper.
Abstr. 5128, line 3: *for* E. J. Kondorski *read* E. J. Kondorskiĭ.
Abstr. 5645, line 3: *for* T. Mortenson *read* T. Mortensen.
Abstr. 5781, line 2: *for* K. Wergeland *read* H. Wergeland.
Abstr. 5911, line 2: *for* H. Kawamuro *read* H. Kawamura.
Abstr. 5994, line 3: *for* H. Schueler *read* H. Schüler.

Index, 1949

Author Index, p. 921: R. H. DAVIES. Insert R. M. DAVIES as author of entry for Abstr. 4194 and cross-reference.

SCIENCE ABSTRACTS

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MATHEMATICS 51

511.6 : 518.2

6192. Tables of powers of complex numbers. I. E. SALZER. *Nat. Bur. Stand., Appl. Math. Ser. No.* 8) 44 *pp.* (1950).

Tables of exact values of these functions are given: 1) $(x + iy)^n$ for x and $y = 1(1)10$, $n = 1(1)25$; 2) x^n for $x = 2(1)9$, $n = 1(1)25$. L. S. GODDARD

517.6 : 538.56 : 535.42

6193. On integrals occurring in the theory of diffraction of electromagnetic waves by a circular disk. C. J. BOUWKAMP. *Proc. K. Ned. Akad. Wet.*, **53** *No.* 5) 654–61 (1950).

A certain integral is evaluated (i) as an expansion in Legendre functions, and (ii) as a hypergeometric series. A list of 37 formulae corresponding to particular values of the parameters is given.

A. T. PRICE

517.63

6194. Note on the inversion of the Laplace transform. B. GROSS. *Phil. Mag.*, **41**, 543–4 (*June*, 1950).

517.9 : 530.145.7

6195. Some theorems on perturbation theory. II. E. C. TITCHMARSH. *Proc. Roy. Soc. A*, **201**, 473–9 (*May* 23, 1950).

The theory of perturbations given in part I [Abstr. 1455 (1950)] is extended to the so-called degenerate case. A.

518.5 : 548.735.4

6196. Two aids for the calculation of crystal structure factors. G. HÄGG. Note in *Acta Cryst.*, **3**, 315–16 (*July*, 1950).

A 10-lever multiplying machine was slightly modified so as to facilitate rapid calculation of angles $\phi = hx + ky + lz$. A device which enables $\cos\phi$ and $\sin\phi$ to be read off easily is described.

A. R. STOKES

518.5 : 621.317.789.082.52

6197. Electrical apparatus for evaluating integrals of products. O. SCHÄFER AND G. LANDER. *Arch. elekt. Übertragung*, **4**, 59–64 (*Feb.*, 1950) *In German.*

An integral of the form $\int_a^b g(\alpha)h(t-\alpha)d\alpha$ is considered. The integrator is a 1-ph. induction meter of which only the first gear is used, the current and the volt coils being connected each to the output of an amplifier. The curves recorded on squared paper are scanned photo-electrically. The apparatus is described and illustrated, applications to problems of regulation, stability, Duhamel and Fourier integrals are given and distortion and errors are discussed.

J. A. WILCKEN (R)

518.5 : 621.318.572

6198. The principle and practice of a mathematical machine called the Electronic Mathematical Operator (OME). B. A. SOKOLOFF. *Ann. Télécommun.*, **5**, 143–59 (*April*, 1950) *In French.*

The machine is capable of solving a canonical system of 9 linear differential equations with 1 independent variable by an extension of the techniques of feedback amplifiers and servomechanisms. The mathematical analysis relevant to such an application is presented and the general functioning of the machine outlined. Two units are then considered in greater detail: the register (2 methods have been used, an oscillograph and a mechanical system) and the associated time-base. Stability and precision are examined comprehensively. Two experimental results are given as examples: the solution of (*a*) the equation of Van der Pol, and (*b*) the response of a particular passive network to an applied step voltage. The wider application of the technique is discussed.

A. J. KENNEDY (R)

519.24

6199. Stochastic processes and statistical inference. U. GRENANDER. *Ark. Mat.*, **1**, *Paper* 17, 195–277 (1950).

A general, and mathematically rigorous, treatment of problems arising in the construction of statistical tests of hypotheses relating to the structure of continuous stochastic processes. There is also a briefer treatment of regression problems for these processes.

N. L. JOHNSON

519.283 : 535.81

6200. The use of statistical analysis in optical manufacture. J. HRDLICKA AND V. BLUMOVA. *Rev. Opt.* (*Théor. Instrum.*) **29**, 265–72 (*May*, 1950) *In French.*

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.6 : 535.246

6201. Researches in astronomical photometry made at the Pierre-à-Bot station in 1947 and 1948. M. DE SAUSSURE. *Arch. Sci.*, **2** (*No.* 3) 454–82 (1949) *In French.*

The relative accuracies of various methods of photographic stellar photometry are examined by applying them to the Pleiades and other standard star fields; it is concluded that methods involving single exposures are more accurate than those with successive exposures. Visual planetary photometry undertaken with a Zöllner-type photometer modified for use with extended objects is applied to the lunar ashen light to give the relative intensity of the earth seen from various phase angles. Thermal photometry with a combination of violet/ultraviolet transmission filter and water cell enables a comparison to be made between variations of solar intensity in the violet and the infrared regions. Variations of some 15% in the near ultraviolet and less than 1% in the infrared are indicated. M. W. OVENDEN

522.6 : 535.33.071–15

Recording infrared spectrometer with high resolving power and its application to the study of the solar spectrum. *See Abstr.* 6350

522.6 : 535.33.072

6202. A reflecting spectrograph of large relative aperture usable in the ultra violet and the infra red. J. BIGAY. *Ann. Astrophys.*, **13**, 72–9 (*Jan.–March*, 1950) *In French.*

Describes a spectrograph for observing feeble sources of light such as the night sky and nebulae. The objective is a spherical mirror, the collimator an aspherical correcting mirror. Spectra 1·7 mm long over 2 000 Å are produced on films, the field being curved. Details of construction, alignment and orientation of the apparatus are given, and a bibliography is appended. E. G. MARTIN

522.614.2

6203. The determination of stellar magnitudes by in-focus photographic photometry. A. MENZIES, R. O. REDMAN AND R. H. STOY. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 647–69 (1949).

Deals with practical points arising during the course of the Cape–Radcliffe photometric programme. A.

522.615 : 535.247.3

6204. A universal device for photo-electric magnitude measurements on celestial objects. P. GUTHNICK. *Abh. Dtsch. Akad. Wiss. Berlin, Math.-nat. Kl.* (*No.* 2) 7 *pp.* (1947) *In German.*

Principles and design of a new instrumental type are discussed; war conditions prevented its actual construction. It embodies the many advantages of a fixed attachment of the apparatus to the lower end of the polar axis of the telescope; from there the observer directs all the necessary movements of dome and telescope, without needing an assistant, and also all the adjustments of the photometer. As an essential improvement a second quite similar telescope is proposed, which, directed from the same switchboard, can be set independently to a different position and fed alternatively into the photocell; the switch-over takes only a few seconds. This second telescope observes the comparison stars, and the hitherto considerable loss of time, and the inaccuracy thus involved by quickly changing atmospheric conditions, is avoided. The most suitable optical solutions for objectives, mirrors, filters, etc., are given. A. BEER

523.112

6205. The expansion of the universe in classical mechanics. G. ARMELLINI. *Atti. Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **8**, 15–20 (*Jan.*, 1950) *In Italian.*

The Newtonian model universe considered has been fully investigated by Milne and McCrea [*Quart. J. Math.* (*Oxford Series*) **5**, 64–80 (*March*, 1934)]. R. A. NEWING

523.162.1 : 535.51

6206. On polarization of radiation by interstellar medium. HILTNER, W. A. Letter in *Phys. Rev.*, **78**, 170–1 (*April* 15, 1950).

The observed polarization of light from 2 distant stars is nearly constant at wavelengths 4 200, 5 500 and 8 000 Å; thus it cannot be caused by the same particles which produce interstellar absorption, sinc this would imply a dependence on $1/\lambda$. Scattering b electrons, suitably oriented by interstellar magnet fields, is also ruled out as an explanation of th polarization, the required electron density ($\sim 17/cm^3$ being too high. D. L. EDWARD

523.34 : 550.3

6207. On the origin of the elliptical or circular area on the moon and of terrestrial seismic regions. N BONEFF. *C.R. Acad. Bulg. Sci.*, **2**, 17–20 (*Apri June and Oct.–Dec.*, 1949) *In French.*

It is suggested that the lunar features were cause by the tidal action of the earth on the solidifying moo at an epoch when (following the theory of G. H Darwin) the moon was much closer to the earth tha now. The absence of similar areas on the earth du to lunar tides is supposed due to the slower solidifica tion rate of the larger body, but possibly the terrestria seismic regions may have a similar origin. M. W. OVENDE

523.4

6208. On the constitution of Mars. K. E. BULLEN *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 688–92 (1949)

It is shown that the earth model based on a com pressibility-pressure hypothesis fits the theories tha the density change across the boundary of the earth's central core is purely a pressure phenomenon and tha the earth and Mars are of the same primitive com position. The fit is best if it is assumed that Mar has an inner core in the same proportion by mass a in the earth and, correspondingly, that the materia in the inner core of the earth is chemically distinc from the material throughout the rest of the eart below the crustal layers. This pair of suggestion receives some support from a consideration of th moment of inertia and ellipticity of Mars. A

523.71 : 537.591.

Solar magnetic moment and diurnal variation i intensity of cosmic radiation. *See Abstr.* 6611

523.7

6209. The nature of the M-regions. M. WALDMEIER *Z. Astrophys.*, **27** (*No.* 1) 42–8 (1950) *In German.*

The author's earlier work on the interpretation o the so-called M-regions (the sources of the sun' corpuscular radiation) [*Z. Astrophys.*, **19**, 21 (1939) **21**, 275 (1942)] is further developed. These ar regions that are first occupied by sunspots and after wards are free from photospheric disturbances for period of several months. An interpretation is give of the remarkable property of the M-regions to occu exclusively in the years just preceding the minimu of sunspot-activity. A

523.7

6210. Solar radiation in the region of wavelengt 10 cm. M. WALDMEIER AND H. MÜLLER. *Z. Astro phys.*, **27** (*No.* 1) 58–72 (1950) *In German.*

The solar radiation at wavelength 10 cm consist of 2 components: a radiation of constant intensit arising from the chromosphere and the corona an a radiation of variable intensity, showing a clos correlation with sunspot-numbers. At times of hig solar activity both components are of about equa intensity. The variable component is interpreted a thermal radiation of the so-called "coronal condens

ons," regions of exceptionally high electron density ound sunspot groups. A.

523.72

211. **A supposed error in Smithsonian solar constant determinations.** K. WEGENER. *Geofis. Pura ppl.*, **16,** 16–18 (*Jan.–March*, 1950) *In German.*

The author's previous paper [*Geofis. Pura Appl.*, 4, 50–3 (*Jan.–March*, 1949)] has been criticized by bbot and Aldrich [*J. Geophys. Res.*, **54,** 404–6 Dec., 1949)] who, e.g., pointed out that the angular rea of the aperture had not been taken properly into ccount. Wegener, however, maintains his view that he present measuring process disregards the proper pplication of the Stefan–Boltzmann radiation laws.

A. BEER

523.746 : 538.566

6212. The growth of circularly polarized waves in he sun's atmosphere and their escape into space. . A. BAILEY. *Phys. Rev.*, **78,** 428–43 (*May* 15, 1950).

The theory, previously published, of plane waves n an ionized medium pervaded by static electric and nagnetic fields is shown to predict wave amplification, nd consequent electromagnetic noise, in certain requency bands. It is then developed in detail for he case in which the static fields are both parallel to he direction of wave propagation and the perturbaions are transverse to this direction. It is shown that or any given frequency and electron drift velocity here are 2 trios of such waves, E_1 and E_2 waves, all ircularly polarized; the E_1 and E_2 waves are oppositely olarized. It is found that any transverse perturbaion temporally prescribed at a given plane can be split up into 2 such trios which can then be considered independently. Necessary and sufficient conditions are then found under which a growing flux of energy carried by E_1 or E_2 waves can pass normally through the boundary between 2 different ionized media. The theory is applied to show that under simple hypotheses about the drift of electrons in the atmosphere above a large sunspot strong circular waves can arise by growth of random transverse perturbations and can then escape from the sun. The consequences of 2 such hypotheses are compared with known observations of solar noise and used to interpret them. It is concluded that the general hypothesis that electrons in a sunspot have a drift motion leads to results which are in good agreement with many facts about strong solar noise and which do not disagree with any others. The ultimate intensity which a growing perturbation can attain is also discussed. A.

525.75 : 551.593.9

The spectrum of the night sky in yellow and red regions. *See Abstr.* 6926

523.752 : 537.591.5

Cosmic-ray intensity following a solar flare. *See Abstr.* 6612

523.755

6213. Polar maps of the solar corona. M. WALDMEIER. *Z. Astrophys.*, **27** (*No.* 1) 24–41 (1950) *In German.*

In this paper 18 heliographic maps of the polar regions of the solar corona are presented which are constructed from observations of the corona in the monochromatic light of the line 5 303 Å. The maps show regions of enhanced line-intensity, the so-called "coronal filaments." These filaments have large dimensions in the direction of heliographic longitude and small ones in the direction of heliographic latitude. The life-time of the filaments amounts to several months. During the period 1939–45 the polar filaments are found in the heliographic latitude of about 60°. Afterwards they were moving towards higher latitudes and reached the poles at the time of sunspot-maximum (1947). The coronal filaments rotate with the same angular velocity as the prominences at the same latitude. A.

523.755 : 523.746

6214. Corona structure in the neighbourhood of a large sunspot group. M. WALDMEIER. *Z. Astrophys.*, **27** (*No.* 1) 73–81 (1950) *In German.*

The paper deals with the distribution of the intensities of the coronal lines 5 303, 5 694 and 6 374 Å around a large sunspot group. The observational material is condensed into heliographic maps of the corona. Another map gives for the same region the heights of the corona as observed in the monochromatic light of the line 5 303. A.

523.77

6215. Fine structure of N_2O near 4·06 μ in the solar spectrum. J. H. SHAW, M. L. OXHOLM AND R. M. CHAPMAN. Letter in *Phys. Rev.*, **78,** 497 (*May* 15, 1950).

523.774 : 523.877

6216. Note on the chemical composition of the sun. M. H. HARRISON. *Astrophys. J.*, **111,** 446 (*March*, 1950).—See Abstr. 5218 (1949).

523.82 : 523.87

6217. The absorption by lines in stellar spectra. N. MILFORD. *C.R. Acad. Sci., Paris*, **230,** 718–20 (*Feb.* 20, 1950) *In French.*

The total loss of light from the continuum due to line absorption is measured from tracings in Hiltner and Williams' photometric atlas for 7 stars of types B8 to K2. Absorptions are tabulated for short wavebands at 27 wavelengths from 4 000–6 600 Å, and the results used to give corrections to photovisual magnitudes of stars of these spectral types.

D. L. EDWARDS

523.842

6218. On a peculiar new eclipsing variable. P. GUTHNICK. *Abh. Dtsch. Akad. Wiss. Berlin, Math. nat. Kl.* (*No.* 7) 15 *pp.* (1947) *In German.*

This is the last published paper of the author who died in September 1947. An extensive series of photometric magnitude observations, at the Berlin-Babelsberg Observatory, of the star ε Ursae Majoris (covering the period May 1946 to March 1947, and achieving an accuracy of 0·005 magnitudes), reveals that this close spectroscopic binary system of 39·48 days' period is also an eclipsing binary of the same period. Its components are of the spectral types G1 and A5. New tentative data are: absolute magnitudes −0·6 and +2·1 magn.; radii $8{\cdot}4\times10^6$ and $0{\cdot}6\times10^6$ km; the masses are 13·5 and 3·4, and the densities $0{\cdot}8\times10^{-2}$ and 5·6 times that of the sun. The presence of a chromosphere of about 9×10^6 km height is indicated, which compares with

the $55–233 \times 10^6$ km for the variable height of the chromosphere of the in many respects hitherto unique case of ζ Aurigae, which is the first instance in which a rather complete analysis of the structure of a stellar atmosphere had become possible. This resemblance and various still quite unexplained spectroscopic and photometric features make intensified further observations of ε Ursae Majoris very desirable, also because of indicated general cosmological conclusions. A. BEER

523.851.4

6219. The calculation of the convergent of a moving cluster of small apparent diameter. R. M. PETRIE. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 693–7 (1949).

523.877

6220. Investigations of the Beta Lyrae system. P. GUTHNICK. *Abh. Dtsch. Akad. Wiss. Berlin, Math.-nat. Kl.* (*No.* 1) 31 *pp.* (1945–46) *In German.*

Photoelectric measurements of β Lyrae were taken in 1943 and 1944 with an orange-red filter, in the expectation that smoother light-curves would result, the irregularities on shorter wavelengths being supposed due to absorption or scattering in the system of gaseous envelopes. This expectation was not realized. Discussion of photographic and photoelectric measures in various spectral ranges taken between 1916 and 1944 indicates that the direction of flow of material between the stars changes direction in a periodic manner with a period of about 18 years, with a consequent variation in the ratio of the radii of the components between 0·681 and 0·815. The results are compared with those of Struve and Kuiper from spectrographic investigations. M. W. OVENDEN

523.877

6221. Remarks on the Compton effect and the hypothesis of the grey body in astrophysics. P. BOUVIER. *Arch. Sci.*, **2** (*No.* 3) 448–53 (1949) *In French.*

Further mathematical development of previous theories put forward by Chandrasekhar [Abstr. 830 (1945); 2027 (1946)] and recently by the author [Abstr. 5912 (1949)], dealing with various refined aspects of the transfer of radiation energy of free electrons. The atmosphere of the stars is here assumed to have a curvature which cannot be neglected. A. BEER

523.877

6222. The structure of stars of non-uniform composition. F. HOYLE AND R. A. LYTTLETON. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 614–30 (1949).

It is shown that models can be constructed on the basis of standard theory to give the largest distensions of radius that are indicated by observations of red giants. The possibility of selection effects is discussed. Consideration of the physical factors that determine whether a star shall be of uniform or non-uniform composition shows why in the case of Type I population the giant sequence is separated by a gap from the main sequence, whereas in Type II population it is connected directly with the main sequence. A.

523.877

6223. Red-giant models with chemical inhomogeneities. LI HEN AND M. SCHWARZSCHILD. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 631–46 (1949).

A stellar model is investigated which contains a difference in chemical composition between t envelope and the interior. The necessary numeri integrations are performed and 15 sample cases this model are computed through in detail. In so cases the model is found to provide stellar ra sufficiently large for moderate red giants.

523.8

6224. Notes on the pulsations of stars. D. RAVENHALL. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 705–10 (1949).

The amplitude of the fourth harmonic mode pulsation of a model proposed by Cowling has be obtained by numerical integration. This mode found to be more stable than the fundamenta A method is given for obtaining approximate formul for the amplitude of any mode.

523.8

6225. Stellar models with variable compositio I. Models with a discontinuity of molecular weigh E. J. ÖPIK. *Proc. Roy. Irish Acad.*, **53 A** (*No.* 1) 1– (*Dec.*, 1949).

Physical characteristics are computed whe $\mu_i/\mu_e = 1$ and 2·1 for various values of M_1/M an M_2/M where M, M_2-M_1 and M_1 are the masses the star the radiative equilibrium zone and th convective core. The models are classified accordin to stability as static, transient, non-static expandin or contracting etc. R. A. NEWIN

523.87

6226. On a generalization of the variational metho for problems of radiative transfer. V. KOURGANOF *Astrophys. J.* **111**, 443–5 (*March* 1950).

525.3

6227. Fluctuations of the earth's annual period rotation. M. LAURENT. *Bull. Acad. Roy. Belge C Sci.* **35** (*No.* 12) 1125–40 (1949) *In French.*

A more detailed calculation has been made of th results obtained earlier by van den Dungen, Cox an Van Mieghem regarding mass of the atmosphere The tabulated values show that there are displac ments of the axis of inertia of the same order as thos indicated in the earlier note. They would be show better if dealt with for all months of the year, a tas to be undertaken later. R. S. REA

525.3

6228. On the influence of the attraction of sun a moon and of the variation of the radius of the ear on its rotation. N. STOYKO. *C.R. Acad. Sci. Pari* **230**, 620–2 (*Feb.* 13, 1950) *In French.*

Theoretical expressions are derived for the vari tions in the length of the day as functions of t combined attraction effects due to sun and moon a the change of the earth's radius. A comparison wi the numerical results from the quartz-clock and oth records obtained in 5 years (1934–37 and 1946–4 shows that the main part of the observed variatio can thus be explained. The remaining differences a attributed to varying meteorological conditions.

A. BE

529.7

6229. Performance survey of the P.T.R. quar clocks and the annual variation in the length of t astronomical day. A. SCHEIBE AND U. ADELSBERGE *Z. Phys.*, **127** (*No.* 4) 416–28 (1950) *In German.*

The rates of the PTR clocks IV–IX were measur

terms of astronomical time signals from Hamburg, Potsdam, Paris and Greenwich from 1934 to 1944. The mean daily rates were found to vary with a period of 1 year and an amplitude of $\pm 0{\cdot}0015$ sec/day. An analysis of the results suggests that the cause must rest in a periodic variation of the time standard, due probably to a variation in the rotational velocity of the earth. L. ESSEN

PHYSICS 53

53 : 014.3

6230. Abstracting and indexing services of physics interest. D. E. GRAY AND R. S. BRAY. *Amer. J. Phys.*, **18**, 274–99 (*May*, 1950).

Details of 145 services with index.

53.081

6231. Planck's units. H. J. RODEWALD. *Z. Naturforsch.*, **5a**, 173 (*March*, 1950) *In German.*

The observation that the masses and radii of the systems: universe, galaxy, star and elementary particle (neutron) are approximately related as follows: $M_i/M_{i+j})^{1/2} = (R_i/R_{i+j}) = a^{1/8}$, $a = 10^{40}$, where the systems are assigned suffices 0, 1, 2 and 8 respectively, is made the basis of a "natural" system of units in which $c = h = k$ (Boltzmann const.) $= 1$ but the gravitational constant is $3\pi/a$. W. J. SWIATECKI

FUNDAMENTALS 530.1

530.12

6232. Unitary theory of the physical field. II. Case of a symmetrical matrix. M.-A. TONNELAT. *C.R. Acad. Sci., Paris*, **228**, 660–2 (*Feb.* 21, 1949) *In French.*

The equation previously established [Abstr. 2945 (1949)] is split into symmetrical and antisymmetrical parts. A solution is given which establishes a connection with the Lagrangian of the Born–Infeld nonlinear theory although no assumptions about the Lagrangian have been made in this work. J. JACOBS

530.12

6233. Unitary theory of the physical field. III. Determination of the fundamental tensors. M.-A. TONNELAT. *C.R. Acad. Sci., Paris*, **228**, 1846–8 (*June* 13, 1949) *In French.*

See preceding Abstr. The tensors F and G are determined on which the Lagrangian depends. The expressions hold even if a gravitational field is present. Equations for a meson field are deduced. J. JACOBS

530.12

6234. The gravitational field of a particle. J. L. SYNGE. *Proc. Roy. Irish Acad.*, **53 A**, 83–114 (*March*, 1950).

The mapping of space-time on to a 4-space is discussed with special reference to the space (u, v, θ, ϕ), where u, v are Cartesian co-ordinates in a Euclidean plane, and θ, ϕ the angular co-ordinates of a point on a sphere. The non-essential character of the Schwarzschild singularity $r = a$ is illustrated by transforming the line element to the form $du^2 - dv^2 + (vdu - udv)^2F + r^2(d\theta^2 + \sin^2\theta d\phi^2)$ where F and r are certain functions of $u^2 - v^2$ involving the positive constant a. The singularity at $r = a$ disappears, and that at $r = 0$ is represented as an infinity of space-like hyperbolae in the (u, v) plane. The general pattern of geodesics in the (u, v) plane is discussed for radial motion and compared with corresponding results for Lemaître's transformation of the Schwarzschild line element [*Ann. Soc. Sci. Brux., Ser. A*, **53**, 51–85 (1933)]. It is shown that a test particle could enter the sphere $r = a$, arrive at $r = 0$ in finite proper time and oscillate infinitely often inside the sphere; a particle could also be emitted from the sphere after an infinite number of oscillations, the proper time period of oscillation in each case being $\leqslant 8a/3$. R. A. NEWING

530.12

6235. The relativistic mass-energy relationship—Has it been verified accurately? S. W. FLÜGGE. *Nucleonics*, **6**, 67–72 (*April*, 1950).

The equivalence principle ($E = mc^2$) leads to the conversion factor 1 mmu $= 0{\cdot}931$ MeV. Experimental results supporting this factor are summarized. The best data so far obtained by mass spectroscopy and reaction energy measurements of the light nuclei (up to Ne^{21}) verify the theoretical value to within $\frac{1}{2}\%$, while other data on fission, β-decay, pair production and annihilation confirm it, but with much lower accuracy. L. R. SHEPHERD

530.145

6236. The adiabatic theorem in the homogeneous canonical formalism. A. WERFELI AND A. MERCIER. *Arch. Sci.*, **2** (*No.* 3) 580–3 (1949) *In French.*

A discussion of adiabatic invariance on the basis of homogeneous canonical coordinates where the variable t is regarded as a coordinate q_{f+1}.

T. C. TOYE

530.145

6237. On the canonical formalism, the accessory condition $H + p_{f+1} = 0$, and the reversibility of the classical mechanics and of the quantum theory. A. MERCIER. *Arch. Sci.*, **2** (*No.* 3) 403–22 (1949) *In French.*

A discussion of the role of the time t in classical and quantum mechanics and the effect of changing t to $-t$. T. C. TOYE

530.145

6238. On Weiss's theory of fields. T. S. CHANG. *Chin. J. Phys.*, **7**, 265–7 (*April*, 1949).

Weiss's theory on the change of Schrödinger wave functional on a surface as the surface changes is given in a complete form, allowing the Lagrangian of the field to contain all derivatives of the field quantities. The integrability of the resulting equation is proved by making use of the fact that the corresponding Hamilton–Jacobi equation is integrable. This gives at the same time a proof of the Lorentz invariancy of the commutation relations between the various conjugate variables, which so far remained obscure as soon as derivatives higher than the second

of the field quantities were allowed to appear in the Lagrangian. A.

530.145

6239. General operator field equations derived from a variation principle. Construction of "divergenceless" four-vector operator. C. GREGORY. Letter in *Phys. Rev.*, **78**, 479 (*May* 15, 1950).

530.145

6240. Infinite matrices used in the theory of quantization. K. V. NIKOLSKIĬ. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 1) 39–40 (1950) *In Russian.*

530.145

6241. An identity in quantum electrodynamics. J. C. WARD. Letter in *Phys. Rev.*, **78**, 182 (*April* 15, 1950).

Theoretical verification of Dyson's conjecture [Abstr. 4487 (1949)] leading to the finiteness of renormalized charge, that the infinite constants Z_1 and Z_2 are equal. J. R. MADDOX

530.145

6242. Quantum electrodynamics—second-order corrections to the current operator. T. A. GREEN. Letter in *Phys. Rev.*, **78**, 297–8 (*May* 1, 1950).

530.145

6243. Five dimensional approach to regularized quantum electrodynamics. Y. KATAYAMA, K. SAWADA AND S. TAKAGI. *Progr. Theor. Phys.*, **5**, 14–24 (*Jan.–Feb.*, 1950).

Maxwellian wave equations and familiar commutation relationships are postulated. Under the assumption that the 5th component of the potential vector vanishes, the latter depend on 2 undetermined functions. Calculations of electron self-energy and vacuum polarization similar to Schwinger's show that the formulism can be made equivalent to Pauli's regularization [Abstr. 47 (1950)]. J. R. MADDOX

530.145

6244. The use of proper time in quantum electrodynamics. I. Y. NAMBU. *Progr. Theor. Phys.*, **5**, 82–94 (*Jan.–Feb.*, 1950).

A notion of proper time, introduced as an additional parameter into the Schrödinger–Dirac equation, is seen to be equivalent to Fock's. A linear formulation of the equations has no practical advantage. A discussion of positron theory and vacuum polarization leads to known results. Feynman's Δ_F arises naturally. J. R. MADDOX

530.145

6245. The interaction representation and configuration space. J. G. VALATIN. *C.R. Acad. Sci., Paris*, **230**, 1456–8 (*April* 17, 1950) *In French.*

The transition from a many-time configuration space to the quantized field theory in the interaction representation is discussed. G. J. KYNCH

530.145

6246. Mass- and charge-renormalizations in quantum electrodynamics without use of the interaction representation. G. KÄLLÉN. *Ark. Fys.*, **2**, *Paper* 19, 187–94 (1950).

The differential equations of quantum electrodynamics are solved in a few special cases without use of the interaction representation of Tomonaga and Schwinger. The results agree with those obtained earlier and the calculations are, at least in the problems treated here, somewhat simpler than before. It m thus be pointed out that the mass- and char renormalizations can be carried out without reference to a system of space-like surfaces. Thi especially convenient when particles of integer s are present, as the interaction operator of Schwin then contains the normal unit vectors of these surfac The end formulae, however, must be independent the normals.

530.

6247. On the mass renormalization and cert aspects of radiation theory. P. MEYER. *C.R. Ac Sci., Paris*, **228**, 1480–2 (*May* 9, 1949) *In French.*

The Schrödinger equation for an electron interaction with radiation is transformed into interaction representation and used to calcul non-relativistically the cross-section for phot electric effect and bremsstrahlung. The results consistent with relativistic calculations of J. Schwing [Abstr. 6182 (1949)] taken in the limit (v/c) is mu less than 1. W. J. SWIATEC

530.1

6248. The covariant formalism of the theory damping. T. MIYAZIMA, M. SASAKI, R. SUZUKI A N. FUKUDA. Letter in *Progr. Theor. Phys.*, **5**, 152 (*Jan.–Feb.*, 1950).

530.1

6249. On the integrability condition of Tomonag Schwinger equation. Z. KOBA. Letter in *Pro Theor. Phys.*, **5**, 139–41 (*Jan.–Feb.*, 1950).

530.1

6250. A self-consistent subtraction method in t quantum field theory. II (2). H. FUKADA, Y. MIYAMO AND S. TOMONAGA. *Progr. Theor. Phys.*, **4**, 121 (*April–June*, 1949).

Continuation of previous calculations [Abs 2917–8 (1950)] of the energy-density of radiatio reaction applied to the Lamb–Retherford shift. note added in proof shows that the numerical resu (for the $2S_{\frac{1}{2}}$ line) agrees with that of American autho Doubts are expressed about the consistency of t procedure in discussions of vacuum-polarization. J. R. MADD

530.145 : 539.1

6251. On the energy level shifts of atoms due to t interaction between the electron and the electromagnet field. O. HARA AND T. TOKANO. *Progr. Theo Phys.*, **4**, 103–12 (*April–June*, 1949).

Apart from the level shift calculated by Bethe, terms are obtained, one of them being interpreted a mass renormalization term and the other, logarithmically divergent term, as a charge renorma ization term. G. J. KYN

530.1

6252. On a new form of the interaction between t electric charges and the e.m. field. L. DE BROGL *C.R. Acad. Sci., Paris*, **229**, 157–61 (*July* 18, 1949) *French.*

The author had suggested in 1935 that the usu expression for the interaction

$$\iint V(r)\rho(R)\delta(r - R)drdR$$

should be modified by substituting for the δ-functi a function with a sharp maximum but of fin

width. This substitution, expressing an uncertainty on the point of application of the field on the charge, leads to a finite value of the self-energy. However at the time it was found impossible to express the idea in a relativistically invariant form. Following a paper by Feynman [Abstr. 1681 (1949)] it is now shown that the correct function to substitute for the δ-function is

$$f(r-R)=\frac{k_0^2}{4\pi}\exp\left(-k_0|\vec{r}-\vec{R}|\right)/|\vec{r}-\vec{R}|$$

$1/k_0$ being a fundamental length. This is equivalent to substituting for a point charge e a continuous charge distribution of density ef. Its self-energy is $e^2k_0/4$. An alternative interpretation is to assume the existence between 2 point charges of a "mesonic" interaction, besides the ordinary e.m. forces.

L. PINCHERLE

530.145

6253. Further observations on the interaction between an electric charge and the e.m. field. L. DE BROGLIE. *C.R. Acad. Sci., Paris*, **229**, 269–71 (*July* 25, 1949) *In French.*

The results of a previous note [see preceding Abstr.] are deduced by an alternative method, based on the author's wave mechanics of the photon. A non-vanishing mass is assumed for the photon; the field is taken as the sum of a "photonic" plus a mesonic field, and the interaction of a charge with these fields is obtained by attributing to it, besides the usual electric charge e, a mesonic charge $-e$. L. PINCHERLE

530.145

6254. On the theory of the subtractive field. L. DE BROGLIE. *C.R. Acad. Sci., Paris*, **229**, 401–4 (*Aug.* 8, 1949) *In French.*

Unquantized field equations related to the author's previous work [see preceding Abstr.] are re-interpreted. J. R. MADDOX

530.145

6255. A remark on the problem of gauge-invariancy. H. UMEZAWA AND R. KAWABE. Letter in *Progr. Theor. Phys.*, **5**, 153–5 (*Jan.–Feb.*, 1950).

The existence of a common numerical factor in the photon self-energy and the zero-point energy of the field interacting with the e.m. field, whatever field is used, is linked with an assumption made in Dirac's earlier hole theory. G. J. KYNCH

530.145

6256. Spinors in five dimensions. K. GOTÔ. *Progr. Theor. Phys.*, **5**, 42–55 (*Jan.–Feb.*, 1950).

Spinor transformations are defined and the properties of spinors of the first, second and higher ranks are developed. Application is made to Bhabha's wave equations for elementary particles [Abstr. 984 (1946)]. The explicit form of certain important matrix transformations is given, and the results are linked with the matrices and wave-functions due to Kemmer. L. S. GODDARD

530.145

6257. On the wave mechanics of the electron. F. BUREAU. *C.R. Acad. Sci., Paris*, **228**, 465–7 (*Feb.* 1, 1949) *In French.*

Equations similar to Dirac's are discussed, but involving only real quantities. Physical differences between the two cases are pointed out, which may help to clarify the origin of several difficulties of the wave mechanics of the electron. L. PINCHERLE

530.145

6258. Particle equations in generalized coordinates. N. SYMONDS. *Proc. Roy. Irish Acad.*, **53 A**, 115–31 (*March*, 1950).

Bhabha's equations [Abstr. 984 (1946)] for particles of integral and half-integral spin are transformed into orthogonal co-ordinates in flat space, and hence to Riemannian space. The case of flat space is discussed in detail, and general rules enable Cartesian equations to be rewritten in terms of orthogonal curvilinear co-ordinates. R. A. NEWING

530.145

6259. Correspondence between the operators of the theory of a single particle and the theory of the positron. J. G. VALATIN. *C.R. Acad. Sci., Paris*, **230**, 925–7 (*March* 6, 1950) *In French.*

530.145

6260. The analytical behaviour of the asymptotic wave-function and the S- or η-matrix for many particles. I. K. WILDERMUTH. *Z. Phys.*, **127** (*No.* 1–2) 92–121 (1950) *In German.*

The S-matrix is examined for problems in which ionization and particle creation may occur. The system chosen consists of 2 interacting particles, one of them being attracted to a fixed point. Only 1-dimensional motion is allowed and the potentials are δ-functions. The problem is solved by iteration to 3rd Born approximation, and it is possible to deduce the behaviour of higher approximations. The S-matrix elements for elastic scattering are analytical functions of the energy, and those for ionization contain logarithmic terms. G. J. KYNCH

530.145

6261. The analytical behaviour of the asymptotic wave-function and the associated S-matrix for many particles. II. K. WILDERMUTH. *Z. Phys.*, **127** (*No.* 1–2) 122–52 (1950) *In German.*

The problem described in the preceding Abstr. is solved in 3 dimensions. The same main conclusions are reached. G. J. KYNCH

530.145

6262. The analytical connection between the scattering matrix elements and the discrete stationary states in the Heisenberg S-matrix theory. K. WILDERMUTH. *Z. Phys.*, **127** (*No.* 1–2) 85–91 (1950) *In German.*

A formulation for calculating the S-matrix for the 2-body problem is given which gives the negative energy eigenvalues without ambiguity or redundant zeros. G. J. KYNCH

530.145 : 539.152.1

6263. Velocity dependent nuclear interactions. C. H. BLANCHARD, R. AVERY AND R. G. SACHS. Letter in *Phys. Rev.*, **78**, 292 (*May* 1, 1950).

Certain of the 6 spin-orbit couplings between nucleons described by Wigner are able to account for the moment anomalies of H^3 and He^3. The interaction of the form

$$J(|r_j-r_k|)[(r_j-r_k)\times(p_j-p_k)]\cdot(\sigma_j+\sigma_k)\left(1-\frac{\tau_{j3}}{2}\tau_{k3}\right)$$

is held to be inconsistent with the observed anomalies. J. R. MADDOX

530.145 : 539.152.1

6264. Non-adiabatic meson theory of nuclear forces. S. M. DANCOFF. *Phys. Rev.*, **78**, 382–5 (*May* 15, 1950).

Two nucleon forces are studied using a technique with which a detailed account of the nucleon recoil during meson emission and absorption may be given. The nucleon motion is treated relativistically. The method is applied to the neutral scalar meson field. It is concluded that the conventional static approximation gives results for this case which are not misleading. It is pointed out that the concept of potential energy is not always applicable in such problems, its validity depending not so much on the "separation" of the nucleons as on the character of the wave function for the state of the system concerned. A.

530.145 : 539.152.1

6265. Meson theory and the electromagnetic properties of the nucleus. J. SERPE. *Mem. Soc. Roy. Sci. Liège*, **1** (*No.* 2) 251–322 (1943) *In French.*

A detailed exposition of meson theory up to terms in v/c using the Møller–Rosenfeld mixture of pseudoscalar and vector meson fields. After the calculation of nuclear forces, the electrostatic field in the neighbourhood of a proton is obtained by perturbation theory. The ambiguities in the results are discussed; in particular, that if the infinities are dealt with in a reasonable way, the negative charge associated with the proton is excessively large. A similar discussion follows a calculation of the magnetic moments. It is then shown that the method of canonical transformations, although identical formally to the order considered, is preferable in that some of the ambiguities are removed. G. J. KYNCH

530.145.6

6266. Enchainment and quantization: Schrödinger's equation for the linear harmonic oscillator. G. VIGUIER. *Rev. Sci., Paris*, **86**, 519–22 (*July–Aug.*, 1948) *In French.*

It is shown that the properties of the eigenfunctions of a linear harmonic oscillator (the Hermite polynomials) may be expressed by means of geometrical properties associated with a Riccati equation.

L. PINCHERLE

530.145.6

6267. The oblate spheroidal wave functions. A. LEITNER AND R. D. SPENCE. *J. Franklin Inst.*, **249**, 299–321 (*April*, 1950).

The wave equation is separable in an oblate spheroidal co-ordinate system. The separation is carried out; and properties of the "angular" and "radial" spheroidal wave-functions are developed. The tabulation of eigenvalues and coefficients by Bouwkamp [*J. Math. Phys.*, **26**, 79 (1947)] is extended up to eigenvalues for functions of order 4, and a large number of angular functions are computed and plotted. L. S. GODDARD

530.145.6

6268. The reflection of a wave at a potential step. H. KOPPE. *Z. Naturforsch.*, **5a**, 137–9 (*March*, 1950) *In German.*

The paper deals with the solutions of the equation $\psi'' + [p(x)]^2\psi = 0$ which satisfy $\psi \to \exp(-ip_2x)$ as $x \to -\infty$, $\psi \to A\exp(ip_1x) + B\exp(-ip_1x)$ as $x \to +\infty$, if $p^2 \to p_1^2, p_2^2$ as $x \to +\infty, -\infty$ respectively. The W.K.B. method when applied to the transformed equation $y' + y^2 + p^2 = 0$ yields zero reflection coefficient $R = |A/B|^2$. This circumstance is explained, and the method is amended to yield an approximate expression for R, the error being of order R^2. P. T. LANDSBERG

530.145.5

6269. The theory of, and methods for solving, many particle problems in wave mechanics. P. GOMBÁS. *Verlag Birkhäuser, Basel* (1950) 268 *pp. In German.*

This book opens with a discussion of Schrödinger's equation, and methods for solving it in simple cases. The H atom and molecule are taken as illustrative examples. The application of the equation to a system of several particles, without interaction, is explained. Spin is introduced and the wave-mechanical formulation of Pauli's principle is discussed. The application to atoms and molecules follows in the next two chapters. Then the various statistics are introduced, for treating problems involving a large number of like particles. A chapter is devoted to wave-quantization. This is where matrix methods are introduced. The quantization of symmetric wave-functions (Bose–Einstein case) and antisymmetric wave-functions (Fermi–Dirac case) is discussed. The second half of the book is given to practical (numerical) methods of calculation. In the first chapter, variational methods are discussed, including those of Ritz, Hylleraas and Slater. Perturbation methods are introduced and applied to the calculation of the polarization of atoms. The method of the "self-consistent field" is explained in another chapter, and the statistical method is discussed briefly in the last chapter. For a more detailed treatment of this see the author's book [Abstr. 4921 (1950)]. There are numerous references to the literature throughout the book. But it is a pity that most of these refer to papers or books published before 1940. L. S. GODDARD

530.145.6

6270. Discussion on the behavior of an electron enclosed in a sphere. T. T. KOU. *Chin. J. Phys.*, **7**, 241–8 (*April*, 1949).

The quantized energy values of an electron enclosed in a spherical box are calculated by solving Schrödinger's wave equation. The energy levels are very close together if the sphere is of ordinary dimensions. But as the radius of the sphere decreases towards atomic dimensions, the value of every energy level increases and the spread between the levels also increases. A.

530.145.7

6271. On the convergence of the perturbation method, II (1). T. KATO. *Progr. Theor. Phys.*, **5**, 95–101 (*Jan.–Feb.*, 1950).

The formal series of perturbation method are considered as asymptotic rather than power series, thus much extending their applicability. Using the operator theory of abstract Hilbert space, conditions are established under which the series represent the eigenvectors ϕ and eigenvalues λ correctly to a desired degree of approximation. Asymptotic expansions for λ, ϕ are significant so long as the coeffs. of the

mal series can be calculated by operations within Hilbert space. J. JACOBS

530.145.7

72. Wave mechanical perturbation theory with aid of the Laplace transform (with an application the Stark effect). H. KALLMANN AND M. PÄSLER. *Phys.*, **126** (*No.* 10–12) 734–48 (1949) *In German.*

In a previous paper [Abstr. 55 (1949)] it was shown w the Laplace transformation can be used to solve ve mechanical perturbation problems, and it was plied to the problem of the Stark effect. An ernative method is outlined in this paper and is o illustrated by means of the Stark effect. The ethod is applicable if the unperturbed differential uation goes over into a linear differential equation the 1st order upon transformation, and if the rturbing function is of the form $\Sigma_i a_i x^i (i \geqslant 2)$, being the independent variable. P. T. LANDSBERG

530.145.7

73. On the integration of the time-dependent rturbed Schrödinger equation. H. KALLMANN AND . PÄSLER. *Z. Phys.*, **126** (*No.* 10–12) 749–59 (1949) *German.*

Continuation of the authors' application of the aplace transform to wave mechanical problems Abstr. 54, 55 (1949), 5188 (1950)] and to perturbation eory [Abstr. 4713 (1950)]. In the latter paper the ne-dimensional time-independent Schrödinger equaon was considered and the perturbing term in the amiltonian was assumed to have a special form. he present paper deals with the three-dimensional me-dependent Schrödinger equation, the variable hich represents the time being changed by applicaon of the Laplace transform. The approximate genfunctions ψ of the perturbed problem (and the pression for $\psi\psi^*$) are obtained and are in agreement ith current theory. P. T. LANDSBERG

530.145.7 : 517.9

Some theorems on perturbation theory. *See Abstr.* 195

530.162 : 531.19 : 536.423.4

274. On condensation in the Bose–Einstein statistics. . RIDEAU. *C.R. Acad. Sci., Paris*, **230**, 1036–8 *March* 13, 1950) *In French.*

The phenomenon of condensation in a Bose–instein gas is discussed, and a relation between pecific heat (C_v) and temperature (T) which differs rom that of London [*Nature, Lond.*, **141**, 643 (1938) nd *Phys. Rev.*, **54**, 947 (1938)] is obtained, the slopes f the C_v–T curves being of the same sign on either ide of the point where a discontinuity occurs in the lerivative, instead of being of opposite sign.

T. C. TOYE

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.51

5275. Dissipative movements in a system of *n* bodies nder Newton attraction. G. F. KHILMI. *Dokl. kad. Nauk, SSSR*, **71** (*No.* 5) 847–50 (1950) *In Russian.*

531.51

6276. Semi-dissipative movements in a system of *n* bodies gravitating according to Newton's law. G. F. KHILMI. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 6) 1041–4 (1950) *In Russian.*

531.53

6277. Forced pendulum oscillations of finite amplitude. F. K. RUBBERT. *Z. Phys.*, **127** (*No.* 1–2) 72–84 (1950) *In German.*

The equation describing the oscillations is reduced to $\kappa_0^{-2}\phi'' + \phi = \phi^3/6 + a\cos mt$, and this non-linear equation is integrated. Special cases of the motion are studied, on the basis of this solution, and the stability of the oscillations is discussed. Three proper frequencies are possible, one of which is always less than the disturbing frequency. These frequencies depend not only on their amplitudes but also on the frequency and amplitude of the disturbance.

L. S. GODDARD

531.53

6278. The dissipation of energy by a pendulum oscillating in air at low pressures. W. H. SHORTT. Letter in *Proc. Phys. Soc., Lond., B*, **63**, 456–8 (*June*, 1950).

MECHANICAL MEASUREMENTS 531.7

531.7 : 621.317.7.085.31

6279. Physical basis of mechanical factors of merit in pivoted measuring instruments. L. MERZ. *Arch. tech. Messen, Issue No.* 168 (*Ref.* J011–2) T3–T4 (*Jan.*, 1950) *In German.*

The Keinath mechanical factor of merit, given by $F_m = 10$ (torque for 90° deflection)/(weight of moving system)$^{1\cdot5}$, is discussed. The view that this factor of merit is empirical is concluded to be unjustified, and that the index 1·5 has a real physical basis. C. F. PIZZEY (R)

531.721

6280. On the polar planimeter. E. P. DÍAZ. *Rev. Cienc. Apl.*, **3**, 359–65 (*Sept.–Oct.*, 1949) *In Spanish.*

531.752

6281. Magnetic suspension balance. J. W. BEAMS. Letter in *Phys. Rev.*, **78**, 471–2 (*May* 15, 1950).

MECHANICS OF FLUIDS 532

532.032 : 512.3

6282. Some metrical ideas related to the equations of Riccati and Schrödinger, which arise in the study of the motion of a viscous fluid. G. VIGUIER. *C.R. Acad. Sci., Paris*, **230**, 1343–4 (*April* 3, 1950) *In French.*

The equation of motion is transformed into a 1st-order equation, and this allows the use of various properties of a plane curve [*Ann. Fac. Sci., Toulouse*, **59** (*No.* 9) (1945)]. In the particular problem studied the Riccati equation arises, and curves with an isometric parametrization are important. A further

change of variable leads to the Schrödinger equation for a linear harmonic oscillator. The appropriate solution here is a Hermite polynomial of degree 2.

L. S. GODDARD

532.122 : 532.77

6283. On the adiabatic compressibility of aqueous solutions. B. JACOBSON. *Ark. Kemi.*, **2**, *Paper* 11, 177–210 (1950).

A theory for the compressibility of solutions is developed for various types of solutions. Experimental determinations of the velocity of sound in a wide range of solutions were made, using an ultrasonic interferometer, the adiabatic compressibility being calculated from the values thus obtained. Good agreement was found between the experimental and theoretically determined values. T. C. TOYE

532.14

6284. The density of heavy water between 25° and 100°C. T.-L. CHANG AND L.-H. TUNG. *Chin. J. Phys.*, **7**, 230–40 (*April*, 1949).

532.511 : 517.948

6285. On the integral equations of hydrodynamics. A. GIÃO. *J. Phys. Radium*, **11**, 219–26 (*May*, 1950) *In French.*

A detailed derivation is given of the integral equations defining the velocity, pressure, density, etc., at each point of a compressible fluid of variable viscosity in general motion in terms of initial and boundary conditions [see Abstr. 5273 (1949)]. An application to perturbation theory is discussed briefly. J. G. OLDROYD

532.513

6286. The extended Bernoulli equation. J. B. KELLEY. *Amer. J. Phys.*, **18**, 202–4 (*April*, 1950).

The vector equation of motion for a non-viscous compressible fluid is integrated along an arbitrary path. The line integral reduces to Bernoulli's equation when the flow is steady and irrotational; more general flow is discussed. J. G. OLDROYD

532.516

6287. Hydrodynamic theory of lubrication for plane sliders of finite width. W.-Z. CHIEN. *Chin. J. Phys.*, **7**, 278–99 (*April*, 1949).

The theory of viscous lubrication is studied from Navier–Stokes' differential equations by the method of successive approximation based upon the smallness of the film thickness. It is found that the first approximation gives the Reynolds' equation of viscous lubrication. To simplify the numerical nature of the solution of Reynolds' equation, the equivalent variational problem is formulated. The approximate solution obtained from the variational problem involves only a very small error but much less amount of numerical work. A.

532.526 : 532.59

6288. Water jump in the boundary layer. I. TANI. *J. Phys. Soc., Japan*, **4**, 212–15 (*July–Dec.*, 1949).

A vertical jet of water is allowed to impinge on a horizontal wall, the water flows radially from the jet along the wall and at a distance (r) a standing wave is formed beyond which the thickness of the water stream is considerably increased. The phenomenon is investigated theoretically on the basis of the boundary layer theory and the results compa with empirical values. T. C. TO

532.

6289. How does a vortex originate in a fluid small viscosity? A. BETZ. *Naturwissenschaften*, (*No.* 9) 193–6 (1950) *In German.*

As the viscosity of a fluid tends to zero, the ene required to produce a concentrated vortex dire tends to infinity, as does the time needed to prod a vortex of finite size directly. But such a vor can be formed indirectly, since a moving plate (example) can produce a concentrated vortex sh the energy required being finite. The sheet th curls up into a roll, and an approximately axisy metric finite vortex is formed by the subsequ diffusion of vorticity. J. G. OLDRO

532

6290. Hydrodynamic forces on a rough w H. A. EINSTEIN AND EL-SAYED AHMED EL-SAM *Rev. Mod. Phys.*, **21**, 520–4 (*July*, 1949).

The dynamic forces which a turbulent flow exe on the individual protrusions of a rough wall ha been measured. It was found that even in the c of an extremely high relative roughness, the dr force on the protrusions may be determined from t logarithmic friction laws. A very significant force which tends to pull the protrusions away fr the wall and into the flow was measured. This force was divided into two parts: A constant avera value and a random fluctuation superimposed o the average. A careful statistical analysis show that the frequency of different pressures or lift for at the wall follows very accurately the normal err law. This fact seems to indicate that in the descripti of turbulence near a rough wall, the pressures mu be regarded as the primary influence, not the velociti

532.

6291. The instability of liquid surfaces when acc lerated in a direction perpendicular to their planes. D. J. LEWIS. *Proc. Roy. Soc. A*, **202**, 81–95 (*June* 2 1950).

An apparatus for accelerating small quantities various liquids vertically downwards at acceleratio of the order of 50 g (g being 32·2 ft./sec.^{2}) is describe and the behaviour of small wave-like corrugatio initially imposed on the upper liquid surface has be observed by means of high-speed shadow phot graphy. The instability observed under a wi variety of experimental conditions has been analyse and the initial phases have been found to agree w with the first-order theory given in Part I [see Abs 3808 (1950)]. When the disturbance has attained considerable amplitude the first-order equatio cease to apply and it changes from a wave into form which has the appearance of large round-end columns of air extending into the liquid and separat by narrow sheets of liquid. The air columns atta a steady velocity relative to the accelerating liqu and continue to penetrate into the liquid until th lower surface of the liquid is reached. In spite these very large surface disturbances, the main bo of liquid below them is accelerated as though th did not exist.

532.595

)2. Oscillations between communicating vessels. Escande. *C.R. Acad. Sci., Paris,* **230,** 924–5 *arch* 6, 1950) *In French.*

The equations governing the oscillation of the uid levels in a system consisting of 3 vessels con- cted by tubes are determined analytically by posing the loss of contents to be negligible. When s assumption is not made the solution can only be tained by repeated approximation using the calculus finite differences. This method does, in fact, able solutions to be obtained for *n* vessels or when e cross-section of a vessel varies. E. H. DOCK

CAPILLARITY 532.6

532.61.08

93. The properties of freshly formed surfaces. A new contracting liquid-jet technique for the udy of soluble films at small surface ages. C. C. DDISON AND T. A. ELLIOTT. *J. Chem. Soc.*, 2789–95 (*Nov.*, 1949).

A method is described which enables the simul- neous measurements of surface tension and surface ge to be made over time ranges not hitherto acces- ble. A quantitative study of the following aspects presented: (*a*) application to pure liquids or ideal lutions of constant surface tension; (*b*) application the study of dynamic surface tensions of aqueous lutions; (*c*) factors (such as surface expansion) hich influence the range of applicability of the ethod. A.

532.612.4 : 532.7

294. The surface tension of liquid metals and the xcess binding energy of surface atoms. R. A. ORIANI. *. Chem. Phys.*, **18,** 575–8 (*May*, 1950).

By assuming that the cohesive energy of a liquid etal can be expressed as the sum of the pairwise nteraction energies of nearest neighbours, and by btaining the number of effective nearest neighbours or atoms on the surface and in the interior from imple considerations, it is shown that the pairwise onding energy of surface atoms is greater than that or atoms in the interior of liquid metals. With Hg 's the sole exception, this excess bonding energy is a nearly constant 2% of the cohesive energy when he liquids are taken as close-packed, but greater ariation of this proportion is obtained when the iquids are taken as solid-like in structure. A.

532.64

295. Modifications of the hysteresis of wetting of vater-paraffin. Role of air retained by the solid urface. L. P. GUASTALLA. *C.R. Acad. Sci., Paris,* 30, 824–5 (*Feb.* 27, 1950) *In French.*

The vertical force on a plate coated with paraffin is neasured as the plate is lowered into water and raised rom it. The curve relating force to depth of plate hows a hysteresis cycle and the size of the loop is dependent on the condition of the solid surface. By treating the paraffin surface in various ways, it is shown that air trapped on the surface by irregularities s the important factor. [See Abstr. 3820 (1950)].

J. IBALL

MOLECULAR THEORY OF LIQUIDS 532.7

532.712

6296. Osmosis in an alternating electric field. Z. LÁSZLÓ. Letter in *J. Chem. Phys.*, **18,** 567–8 (*April*, 1950).

MECHANICS OF GASES 533

533.15

6297. Note on the mathematical treatment of complicated diffusion problems. W. JOST. *Z. Phys.*, **127** (*No.* 3) 163–7 (1950) *In German.*

The equation for one-dimensional diffusion, when the diffusion coefficient depends on the concentration, is non-linear and cannot generally be integrated. Boltzmann gave a method for transforming the equation into one which could be linked more easily with diffusion measurements. This method is extended to deal with discontinuities. It can be applied to the diffusion problem in two-phase systems, which is physically important. L. S. GODDARD

533.15 : 536.2

6298. Optical quantitative method of observation of thermal and diffusion phenomena in plane conditions with small deformations of approximately plane surfaces (grid method). G. A. OSTROUMOV. *Dokl. Akad. Nauk, SSSR,* **71** (*No.* 5) 887–90 (1950) *In Russian.*

The method is said to aim at the direct experimental determination of the Laplace factor included in calculations of the principles governing the propagation and diffusion of heat. The apparatus required is described and theoretically substantiated. Two examples, illustrated by photographs, are given of its working. The first is taken with a vertical temperature gradient, warmest at the bottom, and the second with horizontal temperature gradation, warmest at the right side. Five variants of the method are indicated and it is stated to be applicable to quantitative measurement in all cases of the use of the qualitative penumbral method. J. CLEUGH

533.16

6299. On the viscosity of rare gases. A.-M. SAULGEOT. *C.R. Acad. Sci., Paris,* **230,** 922–3 (*March* 6, 1950) *In French.*

A comparison between experimental (oscillating disk method) results and theoretical values for variation of viscosity with temperature in certain rare gases. A relationship between this variation and atomic weight is established, and theoretical values are shown to be limiting values of a series of experimental results. G. WITTENBERG

533.5 : 621.365.41

6300. A horizontal high vacuum electrical resistance furnace. W. E. KUHN AND O. W. ELLIS. *Canad. J. Res., F.*, **28,** 1–20 (*Jan.*, 1950).

A laboratory furnace designed for high-temperature high-vacuum conditions is described in detail and advanced as a basis of development for large capacity equipment. The de-gassing of refractories is avoided by their enclosure in a sealed metal sheath

and their fitting with a radiation shield. Sealing gaskets were finally made from neoprene and operating pressures of 10^{-3} to 5×10^{-5} mm Hg were obtained in 20 min. Operating temperatures of 1 500°c were easily attained. Ancillary equipment for control and protection is discussed and an indication given of the energy requirements. R. W. J. COCKRAM (R)

533.56

6301. On the theory of pumping under molecular conditions. F. BERTEIN. *C.R. Acad. Sci., Paris,* **230,** 930–1 (*March* 6, 1950) *In French.*

The distribution of non-colliding molecules in gases at sufficiently low pressures is investigated mathematically. G. WITTENBERG

533.6.011.311

6302. Shear stress in a turbulent boundary layer. D. ROSS AND J. M. ROBERTSON. *J. Appl. Phys.,* **21,** 557–60 (*June,* 1950).

The method initiated by Fediaevsky for evaluating the shear stress distribution in a turbulent boundary layer under the action of an adverse pressure gradient is improved upon. Use is made of a more suitable polynomial and boundary conditions which include the concept that the turbulence which produces the shear at any point has its origin at the surface upstream from its present location. This "history" theory predicts that the transverse shear gradient in the outer portion of the boundary layer remains constant as the boundary layer develops. Comparison with shear distributions measured along a simulated airfoil shows good qualitative agreement and appreciable improvement over Fediaevsky's theory. A.

533.6.011.311 : 551.513

6303. The aerodynamic drag of grassland. F. PASQUILL. *Proc. Roy. Soc. A,* **202,** 143–53 (*June* 22, 1950).

An improvised drag-plate apparatus, on the principle of that used by Sheppard on a concrete surface, but suitably modified in design, has been used for exploratory measurements of the aerodynamic drag of grassland. For reasons which are discussed the drag measurements are regarded as approximate, but the general consistency achieved in this preliminary application suggests that the technique could be profitably developed for a critical investigation of the relation between drag and wind profile and its dependence on atmospheric stability. In a brief discussion of previous work some evidence is now provided for the validity of the Reynolds formulation of the turbulent shearing stress. Attention is drawn to the application of the present results in treatments of the diffusion of matter in the lower atmosphere. A.

533.6.011.5

6304. On turbulent jet mixing in two-dimensional supersonic flow. D. BERSHADER AND S. I. PAI. Letter in *J. Appl. Phys.,* **21,** 616 (*June,* 1950).

533.6.011.5 : 517.432.1

6305. Transient source, doublet and vortex solutions of the linearized equations of supersonic flow. W. J. STRANG. *Proc. Roy. Soc. A,* **202,** 40–53 (*June* 22, 1950).

By introducing the Heaviside step function as the time variation of the fundamental source solution the wave equation of compressible gas flow, a fam of "transient" source and doublet solutions is deriv together with a generalization of the vortex, and th more interesting properties are explored. The results are applicable to unsteady supersonic aerof theory and similar problems.

533.6.011.5 : 534.222

6306. On steady one-dimensional flow across transverse or oblique shock-wave. J.-J. BERNAR *C.R. Acad. Sci., Paris,* **230,** 1339–40 (*April* 3, 19 *In French.*

A theoretical investigation of the rapid variation temperature and gas-velocity within a shock-wa taking account of the effects of viscosity and therm conductivity. It is assumed that the viscosity proportional to θ^s where θ is the gas temp. a $0 < s < 1$. Roy and Morduchow and Libby ha shown that the solution of the equations of flow particularly simple when the Prandtl no. $Pr = 3$ and $s = 0$: this note outlines approx. methods solution for other values of Pr and s, but no resu are quoted. A. SCHOFIE

533.65

6307. Transient lift of three-dimensional pure supersonic wings. W. J. STRANG. *Proc. Roy. Soc.* **202,** 54–80 (*June* 22, 1950).

A theory for the transient lift of 2-dimensio supersonic wings given in a previous paper [Abstr. 90 1949] is extended to cover 3-dimensional wings of th purely supersonic class. It is found that a simp function of 2 variables can be defined which ca express all the pressure distributions of this and relate problems. Charts are given for calculating the u steady lift of wings with plan-forms made up of finite number of straight lines, especially delta wing For delta wings, the important parameters are Mac number and chord-distance travelled, the sweep-bac being less significant. It is concluded that plan-for of small aspect-ratio are the most advantageous fro the point of view of gust-loading, on account of the greater chord-length for given area.

MOLECULAR THEORY OF GASES 533.7

533.

6308. A symmetrical relation in the theory o inhomogeneous rarefied gas. M. KOHLER. *Z. Phys.* **127** (*No.* 3) 215–20 (1950) *In German.*

The third approximation (in the Enskog sense) t the viscous pressure and thermal flow component involves a series of material constants. A relatio between these constants, independent of the specia kind of interaction mechanism between the collidin molecules, is deduced. This has therefore a similarity with the Onsager reciprocity relations. The constants appertain to the essential terms in the higher approxi mations to the acoustic equations of motion.

F. E. HOARE

533.7 : 536.7

309. On the thermodynamic phenomenological eory of thermo-diffusion. R. HAASE. *Z. Phys.*, **127** *Vo.* 1–2) 1–10 (1950) *In German.*

From the relations derived by Meixner by the ermodynamic phenomenological method for the ffusion and thermal flow in any binary liquid and is mixture, equations are developed which are uitable for the description of thermo-diffusion and ne diffusion thermal effect in non-ideal liquids and ases. Some general inequalities and the explicit onnection between the different thermal conduction apacities of mixtures are given. With certain ssumptions regarding the phenomenological co-ficients and by the assumption of a suitable equation f state the approximate calculation of the pressure ependence of the thermo-diffusion factors for gases s further advanced. The result of calculation can or the first time be compared with the results at igh pressures (1 to 80 atm.) of Becker and Schulzeff or the gas mixtures H_2/N_2, H_2/CO_2, and N_2/CO_2. hus the pressure dependence of the thermo-diffusion actors and also the concentration dependence at igh pressures (H_2/CO_2) is in general satisfactorily iven. This means that, as already surmised by Becker, a substantial part of the pressure effect epends on deviations of the thermodynamic func-ions from the values for ideal gas mixtures and may e predicted when the equation of state for the ppropriate gas mixture is known. For isotopic nixtures likewise, the equation of state yields a alculable pressure effect. F. E. HOARE

533.7 : 536.7

310. The entropy theorem in inhomogeneous arefied gases. M. KOHLER. *Z. Phys.*, **127** (*No.* 3) 01–8 (1950) *In German.*

The entropy theorem for an inhomogeneous gas is formulated as a general differential. The ntropy density and entropy stream density is umerically evaluated for Maxwellian and rigid pherical molecules in the second approximation as far as quadratic terms in the viscosity coefficient). In the higher approximations the entropy increase due to irreversible processes is no longer determined only by the components of the viscous stress and thermal flow. The employment of certain thermo-dynamic formulae in the higher approximations is therefore not permissible. The entropy theorem is therefore used to find in a relatively simple manner explicit formulae for the viscous stress and thermal flow. The calculation for Maxwellian and rigid spherical molecules confirms the general proposition of a symmetrical relation previously given and the expressions of Lennard-Jones, Burnett and Chapman–Cowling for the viscous stress. F. E. HOARE

VIBRATIONS . ACOUSTICS 534

534.01

311. Relations concerning wave fronts and reflectors. K. S. KELLEHER. *J. Appl. Phys.*, **21**, 573–6 (*June*, 1950).

By means of a vector notation for surfaces, relations are derived for an incident wave front, reflector and reflected wave front. A method is introduced for evaluating the deviation of a wave front surface from a plane. Problems are included in order to indicate the simplicity and utility of the analysis. A.

534.121.1

312. On the vibration of re-enforced plates. I–II. E. GIANGRECO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **8**, 34–8 (*Jan.*); 113–15 (*Feb.*, 1950) *In Italian.*

Starting from the statical problem of the deflection under a load of a rectangular plate reinforced by bars either parallel to the sides or inclined at 45° to them, the author derives, by an appeal to d'Alembert's principle, a differential-integral equation for the normal displacement of the plate during vibration. Developing the kernel of this equation, which is the function giving the statical deflection at (x, y) produced by a unit load at (ξ, η), in a Fourier series of period a in x and ξ and of period b in y and η, respectively, assuming further a solution periodic in the time, the author reduces the differential-integral equation to a set of linear algebraic homogeneous equations. If the development of the kernel is stopped at the nth term, the vanishing of the determinant of the system of n linear equations determines the frequencies of the vibrations. A formula for the fundamental mode is given and a numerical example worked out. Fig. 1 mentioned in the text is not printed and equation (13) which immediately precedes (14) in order is not so numbered. V. C. A. FERRARO

534.21 : 539.132

313. Acoustic relaxation in gases. S. R. DE GROOT. *Ned. T. Natuurkunde* (*No.* 1) 1–13 (*Jan.*, 1950) *In Dutch.*

Mathematical theory shows that changes in intra-molecular vibrational energy are the main cause of the variation with frequency of the velocity and absorption of h.f. sound waves in gases. The exact definition of "relaxation time" is still uncertain and the explanation of the influence on it of impurities in the gas, etc., is obscure. T. S. E. THOMAS

534.22

314. The temperature-dependency of the compression factor in a formula for computing the velocity of sound in liquids. D. SETTE. *Z. Naturforsch.*, **5a**, 170–1 (*March*, 1950) *In German.*

Schaafs' formula for the velocity of sound (v) in organic liquids gives $v = w(RT)^{\frac{1}{2}}sr$, where w is a constant, r is the molecular volume, and s the compression factor. r is the ratio between the effective molecular volume per mol (B) and the molar volume (V). Rao has studied the variation of the velocity of sound with temperature in organic liquids and found that $v^{\frac{1}{3}}V =$ constant K. When these 2 formulae are combined and allowance is made for the variation of density with temperature between the melting point (T_m) and the critical temperature (T_k), it is found that $s/C = (1 - T/T_k)^{0\cdot6}(T_k/T)^{\frac{1}{2}}$, where C is a constant depending on the liquid employed but not on temperature. It is concluded that the percentage change of velocity of sound of a number of liquids for a specific temperature range (e.g. 0–50°C) is approx. constant when their critical temperatures are

not very different, and this is supported by experimental data. A. C. WHIFFIN

534.22

6315. A determination of the speed of sound in air. H. N. MAXWELL AND C. C. ALWAY. *Amer. J. Phys.*, **18**, 192–3 (*April*, 1950).

Velocity of sound in free space is measured by means of a loudspeaker emitting short sound pulses at 1/60 sec. intervals, the distance to a microphone being adjusted so that the received sound pulse coincides accurately with a time marker pulse on a C.R.O. The distance apart of the "speaker" and the microphone is then adjusted until the sound pulse coincides with another time marker pulse. If m is the number of marker pulses passed over, the velocity is found by merely multiplying the distance by $60/m$. The results agree well with the generally accepted value of sound velocity in the open air.

A. B. WOOD

534.22

6316. Compilation of body wave velocity data for cubic and hexagonal metals. L. GOLD. *J. Appl. Phys.*, **21**, 541–5 (*June*, 1950).

The directional variation of body wave velocities has been computed for cubic and hexagonal metals where stiffness coefficients are known; the essential data is presented in the form of tables and graphs. The results for Al, Cu, Au, Fe (α), Pb and Ag are tabulated in terms of the directional indices, and a stereographic coordinate system has been devised for presenting these data in the form of iso-velocity contours for the three wave vectors. The compressional and shear velocities for Cd, Mg and Zn are plotted as a function of the angle formed by the direction of wave propagation and the hexagonal (c) axis from which have been derived the theoretical average velocities which may be compared with measured values for polycrystalline specimens. A.

534.232

6317. Equations of acoustical transmission system. A. A. KHARKEVICH. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 2) 285–7 (1950) *In Russian.*

The behaviour of acoustically interacting surfaces is dealt with on the basis of consideration of mean pressures arising at the radiating surface. In certain applications the equations derived are shown by examples to be simpler than the classical method using the wave equation. W. W. GEHR

534.232 : 538.652 : 537.228.1

The constants of magnetostrictive, electrostrictive and piezoelectric electro-acoustic convertors. *See Abstr.* 6485

534.321.3

6318. The physical structure of Turkish music. S. M. UZDİLEK. *İstanbul Tek. Üniv. Büll.*, **2** (*No.* 1) 67–78 (1949).

534.321.9

6319. Bibliography on supersonics or ultrasonics. B. CURRY AND E. HSI. *Research Foundation, Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma* (1949).

Contains about 650 entries, many with short abstracts, gathered from journals of abstracts in the period 1928–49. Arranged under 72 subject headings, and also under individual authors. Physical, chemical, biological and industrial aspects are covered. The bibliography has been deposited at a number of public and university libraries.

534.321.9 : 533.6 : 532.5

6320. On certain characteristics of ultrasonic emission from high-speed gaseous jets. R. KLING AND O. GUILLOU. *C.R. Acad. Sci., Paris*, **230**, 1736 (*May* 15, 1950) *In French.*

Ultrasonic waves (frequencies 50–400 kc/s) are observed when a high-speed jet emerges from an orifice into the atmosphere. The wavelength varies in a discontinuous manner with the distance of a plane obstacle from the orifice, as in the case of sound waves produced by slower jets. It is concluded that the production of ultrasonic waves is closely associated with the formation of vortices. J. G. OLDROYD

534.321.9 : 541

6321. Ultrasonic velocity in macromolecular substances. G. NATTA AND M. BACCAREDDA. *J. Polym. Sci.*, **4**, 533–7 (1949).

Correspondence. The velocities of ultrasonic waves in liquid paraffins and in various polymers have been calculated according to (i) the bonds and (ii) the radicals, in the paraffin or the polymer. It was found that for most of the paraffins and most of the polymers the velocities calculated according to the radicals were closer to the experimental values than the velocities calculated according to the bonds. The polymers concerned were polythene, polyethylene oxide, polyisobutylene, polyalphabutylene, hydrogenated Buna 32, Butyl rubber, polystyrene, polyvinyl isobutyl ether and polymethyl methacrylate.

RUBBER RESEARCH ASSOCIATION

534.321.9 : 542.952

6322. Emulsion polymerization with ultrasonic vibration. A. S. OSTROSKI AND R. B. STAMBAUGH. *J. Appl. Phys.*, **21**, 478–82 (*June*, 1950).

Emulsion-type polymerization reactions have been accelerated by irradiation with ultrasonic energy. A magnetostriction oscillator at 15 kc/s gave essentially the same results as a piezoelectric oscillator at 500 kc/s. The rate of formation of polystyrene was doubled and higher final yields obtained using about 0·03 W of vibrational power per cm³ of latex. Experiments were made to separate local heating effects from those due to vibrational energy. The ultrasonic intensity apparently must exceed a critical value before an appreciable accelerative effect is observed. Above the critical intensity, the time to reach a given yield of polymer is approximately inversely proportional to the power used.

534·

6323. Sound writing and reading. C. J. OVERBECK. *Research, Lond.*, **3**, 268–74 (*June*, 1950).

A popular account of recent methods of visual translating of sound records, mainly as an aid to the deaf. Examples of this are the solid models built up of a large number of oscillograms, but these are not practicable for general use. An advance in "sound translators" was made possible by the introduction of the magnetic sound spectrograph which produces a 2-dimensional picture of the sound field with intensity as shades of grey or black, the frequency

le being vertical (the y axis) and time horizontal axis). Other sound translators which are now eiving some attention are the "phosphor belt" nslator, and the cathode-ray translator (using a olving cathode-ray tube as a screen). Since the een retains the image for about 2 seconds the ttern can be scanned in word units. The "y" and " deflections and brightness denote frequency, e and intensity, respectively, as before.

A. B. WOOD

534.414 : 532.13 : 536.23

24. The effect of viscosity and of thermal conductivity in an acoustic resonator. I. BARDUCCI. *Atti. Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) 764–74 (*May*, 1946) *In Italian.*

A formula is developed for the calculation of the efficient of resonance in a tube of circular section. is involves the ber- and bei-functions and is mplicated, but various simplifications are introced. Graphs of various functions involved are en and these facilitate application. Similar lculations are carried out for an acoustic resonator.

L. S. GODDARD

534.415

25. Sound frequency spectrometer by the stroboscopic method. F. A. FISCHER. *Fernmeldetech. Z. [TZ]* **3**, 174–80 (*May*, 1950) *In German.*

Discusses the general principles of sound frequency nalysis by stroboscopic methods. Two experimental rangements are described: (*a*) using rotating stroboopic discs of various patterns, and (*b*) using tionary "rasters" and rotating mirrors. Various rms of raster from the simple parallel strip and nusoidal types to the more elaborate hyperbolic ster are considered. Examples of complex waverm analysis are shown in illustration. A. B. WOOD

534.415 : 621.317.39

326. A stroboscopic tuner for musical instruments. . DOUGLAS. *Electronic Engng*, **22**, 178–80 (*May*, 950).

The tuner consists of a series of 12 rotating stroboopic discs, each carrying 7 rows of segments, their umber doubling from inner to outer layer. The strument covers 84 semitones in the 31–4 066 c/s nge. All 12 discs are geared and driven together y a motor, gear ratios being so chosen as to come osest to the tempered scale (the well-known $\sqrt[12]{2}$ lation) with an accuracy of about 25 times greater an that of the human ear. The motor driving mplifier is controlled by a high precision adjustable ning fork. Neon tubes, fitted behind every disc, are nergized via an amplifier from a microphone, and ght bands appear in calibrated windows covering e discs. A. LANDMAN (R)

534.442

327. On the so-called interference phenomenon in he Quincke tube. D. HAHN. *Ann. Phys., Lpz.*, 7 *No.* 1–2) 81–7 (1950) *In German.*

Deals with the simple theory of the Quincke tube n which stationary waves are set up in the two alternative" paths. An experimental investigation is described using two alternative methods of exploring he sound distribution in the tube system: (*a*) the dust-figure method, with a transparent glass Quincke tube containing a sprinkling of fine powder to indicate the position of nodes and anti-nodes; (*b*) the listening method, using an auxiliary "exploring" tube to investigate the maxima and minima of sound intensity, as the frequency is varied near resonance.

A. B. WOOD

534.612.2

6328. Electroacoustic measurements on the celebrated baroque organs of Upper Swabia. II. Tone analysis experiments. W. LOTTERMOSER. *Z. Naturforsch.*, **5a**, 159–68 (*March*, 1950) *In German.*

For Pt I see Abstr. 922 (1949). Measurements were made of the acoustic spectrum of individual pipe tones with a magnetophone microphone and electrical filter circuits. T. S. E. THOMAS

534.62 : 621.395.61/.62

6329. Acoustic test-room for loud-speakers and microphones. M. MILOSEVIC. *Rev. Tech. C.F.T.H.* (*No.* 13) 33–42 (*Feb.*, 1950) *In French.*

Constructional details are given together with results of an exploration of the sound field. It is shown that a region can be obtained in which free-space propagation is possible and which can be used for investigating response curves, motional impedances and distortions of loud-speakers and microphones and also the directivity of microphones.

G. F. HODSMAN (R)

534.844

6330. Simplified reverberation-time calculation. L. S. GOODFRIEND. *Audio Engng*, **34**, 20–1 (*May*, 1950).

A graphical presentation of the Eyring formula for determination of the reverberation time of enclosures.

A.

OPTICS . RADIATION . SPECTRA 535

535.1

6331. A new formulation of the Huygens-Fresnel principle. E. PERUCCA AND L. A. RADICATI. *Atti. Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1**, 901–6 (*Sept.*, 1946) *In Italian.*

A physical interpretation of the Kirchhoff formula leads to the consideration of pressure, velocity and displacement waves. For a plane wave, neglecting the displacement waves, and taking as source of the wavelets the wave surface itself, the H.-F. principle may be formulated as follows: The vibration at any point is the algebraic resultant of the elementary wavelets dX starting from all surface elements dS of a wave surface, where

$$dX = [(\cos\theta + 1)/4\pi r][\partial f/\partial x]_{t-r/v}dS$$

For a sinusoidal wave $f = a\cos 2\pi(t/T - x/\lambda)$, one has in particular:

$$dX = [(\cos\theta + 1)/2\lambda r]a\cos 2\pi(t/T - x/\lambda - r/\lambda + 1/4)dS$$

L. PINCHERLE

535.1

6332. The reversibility of lightpaths. C. v. FRAGSTEIN. *Phys. Bl.* (*No.* 4) 152–9 (1950) *In German.*

535.1 : 538.56

6333. Singular case of Huyghen's problem. J. BRODIN. *C.R. Acad. Sci., Paris,* **230,** 1345–7 (*April* 3, 1950) *In French.*

Exceptional cases of Huyghens' problem for electromagnetic waves exterior to a closed surface and satisfying Sommerfeld's *Ausstrahlungsbedingung* are discussed with the aid of an auxiliary vector space.

A. T. PRICE

535.1 : 538.56

6334. Vector space for waves regular outside a closed surface. J. BRODIN. *C.R. Acad. Sci., Paris,* **230,** 1388–90 (*April* 12, 1950) *In French.*

The solution of the Huyghens' problem for a monochromatic wave, which is regular outside a closed surface S and at infinity, is expressed as a series of waves produced by surface distributions of electric and magnetic dipoles tangential to S. This expression contains arbitrary coefficients allowing the solution of particular problems.

A. T. PRICE

535.214.6

6335. Negative photophoresis. T.-T. OUANG. *C.R. Acad. Sci., Paris,* **230,** 1518–20 (*April* 24, 1950) *In French.*

By means of a differential torsional pendulum sensitive to 10^{-6} dyne it is found that when light falls on very small particles sandwiched between two sheets of mica, a force acts in a direction opposite to the incident light. The effect of the light on the mica is counterbalanced by a similar arrangement without the particles. The pressure was $\sim 5 \times 10^{-6}$ mm Hg.

N. CORCORAN

535.214.6 : 538.12

6336. On photophoresis and an effect of solar light in causing a rotation of matter in a vacuum: influence of a uniform magnetic field. F. EHRENHAFT AND K. V. DESOYER; A. COTTON. *C.R. Acad. Sci., Paris,* **230,** 1654–7 (*May* 8, 1950) *In French.*

A small Fe particle, falling freely, moves under the combined influence of solar light and a uniform magnetic field, as if it were a free N pole. Similar results are observed for ferro-magnetic and other metals. In the case of particles whose locus in the absence of a magnetic field is a fixed circle, the effect of a uniform magnetic field is to displace the circle in the direction of the field. Cotton points out that the pressure was between 5 and 10 mm Hg in the different experiments, and states that Tauzin has experimental grounds for not accepting the above conclusion.

N. CORCORAN

535.22 : 531.719.29

6337. A determination of the velocity of light. E. BERGSTRAND. *Ark. Fys.,* **2,** *Paper* 15, 119–50 (1950).

A new determination of the velocity of light by Fizeau's principle, the intermittent source being provided by light from an incandescent lamp which traverses a Kerr cell placed between crossed Nicols and subjected to high-frequency tension from a crystal oscillator. Full experimental details are given. The velocity of light *in vacuo* is found to be 299 793·1 ± 0·25 km/sec. The instrument, "geodimeter," is intended for further use in accurate measurement of distances.

E. M. FOURNIER D'A

535.3

6338. Radiation measurements on electrically hea SiC rods. W. BRÜGEL. *Z. Phys.,* **127** (*No.* 4) 40 (1950) *In German.*

The use of SiC rods as infrared sources is discuss By optical pyrometry at 6 650 Å the true temp. T_w a rod was determined from a small black body ca made in it, also the apparent surface temp. Between $T_w = 1\,000°$ and $1\,800°$K, T_w–T_s showe linear increase from 15° to 40°. The emissivity E 6 650Å could be calc. from these observations Wien's law, but for other wavelengths up to 1 it was derived from the spectral distribution of ene from SiC and a separate black body, both at 1 243 The temp. coeff. of E at selected wavelengths calc. by Planck's equation from the emission obser between 1 000° and 1 800°. E had a max. va $\sim 0{\cdot}87$ at $\sim 8{\cdot}5\,\mu$ and a linear rise with T at ea wavelength, while dE/dT was a max. at $\sim 9{\cdot}5\,\mu$.

S. T. HENDER

535.247 : 535.371

6339. Light energy and spectral distribution for so important X-ray screens. H. SKÖLDBORN. *J. Ap Phys.,* **21,** 546–51 (*June,* 1950).

The absolute energy of the light (ergs/cm² per *r*-u and its spectral distribution have been determined four different types of X-ray fluorescent screens by objective spectrophotometric process. The appli tion of the method employed to the weak li intensities in question is made possible by the en mous light sensitivity of the multiplier photo-t and the possibility of reproducible continuo variation of this sensitivity within very wide lim The method has proved speedy and accurate a appears to be well suited for investigations of simi character, within the spectral range which may measured by the commercial types of multipl photo-tubes.

535.24

6340. On the effective wavelength of a pseudomon chromatic photo-electric system. G. RIGHINI. *A Fond. "Giorgio Ronchi,"* **5,** 65–70 (*April,* 1950) *Italian.*

The effective wavelength of a system composed a radiator, a coloured glass and a photocell is define Its physical meaning and the methods for obtaini this very important quantity are discussed.

535.24

6341. New semi-automatic distribution photomet and simplified calculation of light flux. G. BAUMGARTNER. *Illum. Engng, N.Y.,* **65,** 253– (*April,* 1950).

An instrument is described in which the variati of candle power with latitude may be measured a recorded for different bearings. The light sou remains fixed, and a photometer (with appropri colour filter) is rotated about the source on a 20 arm. The photocurrent is measured on a recordi galvanometer, the drum of which is geared to t arm which carries the cell. The instrument produ

graph of candle power against latitude, and the ...rce is rotated about a vertical axis to enable a ...ilar curve to be taken for another bearing. A set ... nomograms is used to determine the coefficients ... utilization for the indirect, horizontal and direct ...mponents. N. CORCORAN

535.247.4 : 621.383.2

...42. On the shape of the sensitive cathode area of ...ectron multiplier photo-tubes. E. W. PETERSON AND ... H. HOLLAND. Letter in *J. Opt. Soc. Amer.*, **40**, ...3 (*April*, 1950).

535.31

...43. Notes on the catadioptric systems of Bouwers. ... SWINGS. *Bull. Soc. Roy. Sci. Liège*, **19**, 168–76 (*March*, 1950) *In French.*

The author derives algebraic expressions for the ...alculation of optical systems in which the spherical ...berration of one or more spherical mirrors is cor...ected by a concentric meniscus and numerical ...xamples of their use are given. The possibility of ...orrection by a plane parallel plate placed in the ...onvergent beam is pointed out, although the neces...ary thickness leads to considerable chromatic ...berration and coma. R. W. FISH

535.317

...344. On a general theory of images in optical ...ystems possessing a plane of symmetry. M. DI JORIO. *...ttica*, **2**, 49–53 (1948).

A formula is developed which must be fulfilled for ...ll the rays of a bundle if the caustic of a neighbouring ...oint is congruent to the caustic of the object point ...uch that homologous rays are connected by a fixed ...ranslation and rotation. A measure is given for the ...eviation from the formula. This measure is not an ...nvariant of the bundle unless the theory is restricted ...o the neighbourhood of a principal ray.

MATHEMATICAL REVIEWS

535.317.1 : 535.12

...5345. A theoretical study of the formation of moving ...point images. The kinematic nature of the Abbe and ...Herschell conditions. M. RISCO. *J. Phys. Radium*, **11**, 159–63 (*April*, 1950) *In French.*

A point source is supposed to move rapidly between ...2 neighbouring positions and an image is formed by ...an optical system. The general relationships of the ...image formation are deduced by a double application ...of the Doppler principle and for non-relativistic speeds ...these are shown to reduce to the Abbe and Herschell ...conditions. The relativistic change of speed and ...frequency in the Gaussian image of a point source ...moving from infinity along the optical axis of the ...system is found. R. W. FISH

535.317.3

6346. The chromatic aberration of the principal ray. G. KORFF. *Optik*, **6**, 245–50 (*April*, 1950) *In German.*

The point of intersection of a principal ray with the image plane varies with the wavelength of the light and, unlike the chromatic difference of magnification, with the position chosen for the image plane. Algebraic computing equations are derived for this form of the chromatic aberration, and it is shown to vanish for symmetrical systems with symmetrical passage of the rays. R. W. FISH

535.317.6

6347. Instrumental optics. II. J. ROSENHAGEN. *Optik*, **6**, 189–218 (*April*, 1950) *In German.*

Contains the application of the general methods of the first part [Abstr. 5674 (1950)] by which the path of a ray is computed through an instrument by matrix calculus. Mirror sextants and the errors of geodetic and astronomical instruments are considered. The theory of prisms free from dispersion is derived and applied to right-angled, roof, Dove and Abbe prisms. Flat plates and plane mirrors are also treated.

R. W. FISH

535.317.9

6348. The sine condition for a thick lens. VIOLETTE. *Rev. Opt. (Théor. Instrum.)* **29**, 259–64 (*May*, 1950) *In French.*

Differential equations are deduced for the faces of a thick lens which for a given magnification (g) has zero central aberration and obeys the sine condition. Starting from suitable radii on the axis it is possible to calculate outwards step by step and so find the two profiles. The equations are simplified when $g = \infty$ and $n^2 = n + 1$ (n = refractive index).

G. F. LOTHIAN

535.33 : 535.822

6349. Microspectroscopy. J. R. LOOFBOUROW. *J. Opt. Soc. Amer.*, **40**, 317–25 (*May*, 1950).

Microspectroscopy involves the combination of microscope and spectroscope optics for the purpose of investigating the spectra of small samples. The general methods of microspectroscopy are described as applied to absorption measurements in the ultra-violet, visible, and infra-red regions, emission spectroscopy, and other applications. Recently developed components and systems for microspectroscopy are emphasized, and some of the important requirements for their effective design and use are considered briefly. A.

535.33.071–15 : 522.6

6350. On the construction of a recording infrared spectrometer with high resolving power and its application to the study of the solar spectrum and of water vapour in the region 13 440 to 15 293 Å. M. MIGEOTTE. *Mem. Soc. Roy. Sci. Liège*, **1** (*No.* 3) 525–634 (1945) *In French.*

Reviews various infrared spectrometers and describes in great detail the form chosen. It is intended to cover the region 1 to 25 μ, with 5 plane gratings, and a foreprism of NaCl or KBr is used as a filtering monochromator. Pfund plane mirrors are used so that the 2 concave mirrors are used on axis. The radiation emerging from the exit slit is concentrated on a thermopile with an ellipsoidal mirror. The apparatus has been applied so far in the short wave infrared, between 1·344 and 1·5293 μ, for the study of the sun spectrum, and 284 new lines have been recorded. Water vapour also was studied.

A. C. MENZIES

535.33.072

6351. Notes concerning spectrographs of high luminosity. P. SWINGS. *Bull. Soc. Roy. Sci. Liège*, **19**, 158–67 (*March*, 1950) *In French.*

Reflecting systems, using meniscus correcting

plates, as cameras of high luminosity for the visible and u.v. region, are described. Interchangeable prism trains of glass or synthetic crystals can be used with these cameras for Raman spectroscopy, etc. Optical data for a number of these systems are given together with the dispersion and resolving power of each. R. W. FISH

535.331 : 551.593.9

On the origin of the sodium *D*-lines during twilight. *See Abstr.* 6914

535.338.1

6352. Preliminary list of levels and *g*-values for Ta II. C. C. KIESS, G. R. HARRISON AND W. J. HITCHCOCK. *J. Res. Nat. Bur. Stand., Wash.*, **44**, 245–6 (*March*, 1950).

A new description of the spectrum emitted by singly ionized Ta atoms has been compiled. The list of wavelengths contains about 2 500 lines between 5 300 and 2 000 Å. About a third of these lines, including most of the strong ones, have been classified as transitions among energy levels that were identified with the help of well-resolved Zeeman patterns. The low and metastable levels arise from the electron-configurations $5d^2\,6s^2$, $5d^3\,6s$ and $5d^4$. The higher levels with which the low ones combine arise from the excited configurations $5d^2\,6s\,6p$ and $5d^3\,6p$. The presence of the $d^2\,s^2$ configurations in ionized Ta, almost equal in stability with $d^3\,s$, is noteworthy because it is unknown in the homologous V and Cb ions. A.

535.338.3

6353. Structure and new energy levels of the arc spectrum of manganese. II. O. G. RIQUELME. *An. Real Soc. Esp. Fis. y Quim.*, **45 A**, 547–76 (*Nov.–Dec.*, 1949) *In Spanish.*

See Abstr. 4823 (1950). Tables are given of all the known energy levels and all the classified lines of Mn I. L. PINCHERLE

535.338.32

6354. On the diffusion of imprisoned resonance radiation. F. N. EDMONDS, JR. *Phys. Rev.*, **78**, 424–8 (*May* 15, 1950).

The solution of the problem of diffusion of imprisoned resonance radiation obtained by Chandrasekhar is worked out in detail in the 2nd approximation. Decay constants, characteristic roots and eigenfunction coefficients necessary for an explicit solution are tabulated for both large and small optical thicknesses. A comparison is made between computed and measured decay constants for the Hg 2 537 Å resonance line. A.

535.338.332

6355. The anomalous fine structure of the He^+-line $\lambda = 4\,686$ Å. H. KOPFERMANN, H. KRÜGER AND H. ÖHLMANN. *Z. Phys.*, **126** (*No.* 10–12) 760–8 (1949) *In German.*

From the position of the component $4^2P_{1/2} \rightarrow 3^2S_{1/2}$, determined by means of a Fabry–Pérot interferometer, the energy difference between the $3^2S_{1/2}$ and the $3^2P_{1/2}$ terms of He II was found to be $0{\cdot}118 \pm 0{\cdot}003\ cm^{-1}$. A comparison with Skinner and Lamb's measurements of the $2^2S_{1/2}$–$2^2P_{1/2}$ energy difference shows that appreciable deviations exist from the theoretical n^{-3} law. The $4^2S_{1/2}$–$4^2P_{1/2}$ energy difference was estimated to be about $0{\cdot}06\ cm^{-1}$. L. PINCHERLE

535.338.33

6356. Revision of the hyperfine structure of the spectrum of mercury. K. MURAKAWA. Letter in *Phys. Rev.*, **78**, 480 (*May* 15, 1950).

535.338.332 : 539.152.

6357. The fine structure of the hydrogen α line. H. KUHN AND G. W. SERIES. *Proc. Roy. Soc., A*, **202**, 127–42 (*June* 22, 1950).

A new attempt has been made to resolve spectroscopically the fine structure of the α line, 6 563 Å, of the Balmer series of heavy H. A D discharge tube whose walls were partly of Cu, was immersed in liquid H and run at very low current densities. By this means the Doppler width of the individual lines was sufficiently reduced to enable the satellite between the main components of the "doublet" to be resolved much more completely and to be measured more accurately than was possible before. The spectroscopic resolution was achieved with a Fabry–Pérot interferometer of large diameter, mounted internally in a prism spectrograph. The measurements support the assumption that the $2S_{\frac{1}{2}}$ term is higher than is predicted by the Dirac theory, and lead to the value $0{\cdot}0369 \pm 0{\cdot}0016\ cm^{-1}$ for the amount of the shift in good agreement with the latest value found by Lamb and Retherford from microwave measurements. The relative widths of the main components and the interval between them also provide qualitative evidence for the shift of the $2S_{\frac{1}{2}}$ term. The intensities of the lines were found to agree approximately with the prediction of the Dirac theory. The weak line $2P_{\frac{3}{2}}$–$3S_{\frac{1}{2}}$ was partly resolved from the neighbouring strong line $2P_{\frac{3}{2}}$–$3D_{\frac{3}{2}}$. The provisional value for the distance between them would indicate that the $3S_{\frac{1}{2}}$ term is shifted very little, if at all. A.

535.338.333

6358. Isotope shift in the resonance lines of zinc. M. F. CRAWFORD, W. M. GRAY, F. M. KELLY AND A. L. SCHAWLOW. *Canad. J. Res., A*, **28**, 138–43 (*March*, 1950).

The isotopic structures of the Zn I resonance lines 2 139 Å ($4s^2\,^1S_0$–$4s4p\,^1P_1$) and 3 076 Å ($4s^2\,^1S_0$–$4s4p\,^3P_1$) excited in an atomic beam source have been resolved with a Fabry-Pérot etalon. Shifts in cm^{-1} relative to the Zn^{64} component are $+0{\cdot}016$ and $+0{\cdot}033$ in 2 139 Å, and $+0{\cdot}023$ and $+0{\cdot}046$ in 3 076 Å for Zn^{66} and Zn^{68}, respectively. When the normal mass shifts are subtracted, the residual shifts for Zn^{68} are $+0{\cdot}010$ (2 139 Å) and $+0{\cdot}030\ cm^{-1}$ (3 076 Å). The field effect theory of isotope shift predicts equal shifts and the specific mass effect predicts unequal shifts for the ^1P and ^3P levels. Therefore the difference of these residuals is a specific mass effect. The difference has the sense predicted by the specific mass theory and its value, $0{\cdot}020\ cm^{-1}$, is a large fraction of the observed shifts. Thus the specific mass effect must be taken into account before the field effect theory can be used to obtain nuclear properties from isotope shifts in intermediate elements. A.

535.338.333 : 539.152.1 : 539.155.2

). Isotope shift in the spectrum of neutral lead. . MANNING, C. E. ANDERSON AND W. W. WATSON. *s. Rev.*, **78**, 417–19 (*May* 15, 1950).

he isotope shift and the Pb^{207} h.f.s. in 9 of the ngest Pb I lines in the violet and ultraviolet regions e been measured, using material enriched in the isotope. For all lines with measurable structure 204–206 interval is less than the 206–208 interval. he resonance line λ2833 and in λ3639, for both which the measurements are almost completely ffected by superposed h.f.s., the ratio of the 204–206 he 206–208 interval is 0·89 and 0·82 respectively. average of our observations and others for the ggering of the centre of gravity of the 207 com- nents for all lines is about 0·63 for the ratio of the –207 and 207–208 intervals. Isotope splitting of ut 0·050 cm^{-1} in the $6p6d$ levels contributes ther evidence of perturbations by $6p7s$ and $6p8s$ els. The staggering is discussed in terms of Breit's ory of polarizability of nuclei by electrons. These isotope shifts indicate decreasing nuclear stability he progression 204 to 208. A.

535.338.4

50. The band spectrum of boron monofluoride (BF) in the Schumann region. M. CHRÉTIEN. *Helv. Phys. Acta*, **23** (*No.* 3) 259–87 (1950) *In German.*

Four new band-systems [Abstr. 5332 (1949)] are scribed in detail. The results for ^{11}BF are sum- arized below.

ate	ν_e	ω_e	$x_e\omega_e$	$y_e\omega_e$	B_e	α
Π	72 140	1 696	14	—	—	—
Σ	69 008	1 608·8	14·3	—	—	—
Σ	65 334	1 693·0	12·7	—	1·66	—
Π	51 151	1 271·8	15·0	+0·10	1·423	0·018
Σ	0	1 400·6	11·2	+0·016	1·518	0·017

he internuclear distance, r_e'', is 1·262 Å, and the ergy of dissociation, D'', got by extrapolation of e vibrational levels in $A'\Pi$, is 8·5 ± 0·5 eV. This considerably larger than the average bond-energy BF_3, 6·7 eV. The vibrational scheme for another stem which may arise from BO is given.

R. F. BARROW

535.338.4

361. Emission of the atmospheric bands ($^1\Sigma_g^+ \rightarrow X^3\Sigma_g^-$) of O_2 in pure oxygen. R. HERMAN ND C. WENIGER. *C.R. Acad. Sci., Paris*, **230**, 940–2 *March* 6, 1950) *In French.*

The emission spectrum of pure O_2 was examined pressures between 10^{-5} mm of Hg and 60 kg/cm^2. ands previously known in absorption were found, so lines due to O I and O II, and numerous u.v. ands and a continuum of indeterminate origin. he different parts of the emission appear in different ressure ranges. S. T. HENDERSON

535.338.4

362. Ultra-violet band-systems of CF. E. B. NDREWS AND R. F. BARROW. Letter in *Nature, ond.*, **165**, 890 (*June* 3, 1950).

535.338.4 : 537.523 : 539.153

363. Emission of forbidden lines (O I) 6 300 Å ($^3P_2$–$^1D_2$) and (O I) 6 364 Å ($^3P_1$–$^1D_2$) by molecular decomposition. R. HERMAN AND C. WENIGER. *C.R. Acad. Sci., Paris*, **230**, 1594–5 (*May* 3, 1950) *In French.*

A high tension discharge in O_2 at atmospheric pressure produces a strong Schumann–Runge band system (table of new bands given), and also the forbidden auroral lines of O I. These presumably occur as a result of the dissociation of O_2 in the upper state $B^3\Sigma$ of the band system to O atoms in the states ^3P and ^1D. S. T. HENDERSON

535.338.4 : 551.594.51

6364. New suggestions on the subject of the interpretation of the spectra of aurorae. M. NICOLET AND R. DOGNIAUX. *J. Geophys. Res.*, **55**, 21–32 (*March*, 1950) *In French.*

"Synthetic spectra" of auroral band-systems are constructed by integrating a number of superposed rectangles: each rectangle, width, Δ, and height, I, represents a rotational line, where Δ (in angstroms) is the width of the monochromatic slit image, and I is the theoretical line intensity. Calculations based on this method successfully explain important features of the auroral spectrum. D. R. BARBER

535.338.41 : 535.39

6365. Selective reflection from mercury and cadmium vapors. H. L. WELSH, J. KASTNER AND A. C. LAURISTON. *Canad. J. Res., A*, **28**, 93–112 (*March*, 1950).

Selective reflection in the neighbourhood of the resonance lines was investigated quantitatively using incident light of continuous spectral distribution. For a given experimental arrangement the lowest vapour density (atoms per cubic centimetre) at which selective reflection could be detected at Hg 2 537 Å, Cd 2 288 Å, and Cd 3 261 Å was inversely proportional to the oscillator strength (f-value) of the absorption line. Contours of the selective reflection of the Hg 2 537 Å and Cd 2 288 Å lines were obtained over a large range of vapour densities up to 80×10^{18} atoms per cc. At this density the Cd reflection extended over several 1 000 cm^{-1} compared to about 100 cm^{-1} for Hg. The general features of the reflection contours can be explained by the theory of reflection from an absorbing medium. Fitting a theoretical curve to the experimental reflection contour yields values of the oscillator strength and the damping constant. For Hg 2 537 Å and Cd 2 288 Å the f-values are 0·0268 and 1·40 respectively, in good agreement with those found by other methods. The damping constant, γ, varies as the square root of the number of atoms per cubic centimetre, indicating that the mechanism of selective reflection is not the same as that for absorption and emission. An empirical areal law for selective reflection confirms the relationship $\gamma \propto \sqrt{N}$. A shift of the resonance frequency of the order of magnitude of the coupling shift calculated by Weisskopf was observed for Hg 2 537 Å. Deviations from theory at both high and low pressures were observed for Cd 2 288 Å. The low pressure deviation takes the form of a line of residual intensity at the resonance frequency, which may be due to a different kind of selective reflection. A.

535.339

6366. On the focusing of concave grating vacuum monochromators with normal incidence for the ultra-violet. S. ROBIN. *J. Phys. Radium*, **11**, 247–8 (*May*, 1950) *In French.*

The mechanism for rotating the grating and automatically adjusting the focus of an actual monochromator is described and shown to lead to acceptable focusing only over a narrow spectral range. Other methods are proposed for use with the same type of apparatus to overcome this disadvantage.

R. W. FISH

535.339

6367. A monochromator with a catadioptric objective of large aperture. R. LOCHET AND J. CLASTRE. *Rev. Opt.* (*Théor. Instrum.*) **29**, 272–85 (*May*, 1950. *In French.*

For the Raman spectra of crystalline powders, a monochromator of large aperture and resolving power is required. A prism monochromator using a concave mirror as objective and a concentric plano-concave correcting lens is described. Calculation of the geometric circle of least confusion leads to an optimum design having an aperture of $f/0{\cdot}64$, a circle of confusion of 94 μ, and a band width of 50 Å in the region around 4 500 Å. The mechanical design of the instruments, methods of adjustment and the arrangements for holding the powder samples are discussed in detail. R. W. FISH

535.341

6368. Continuous absorption of light in sodium vapour. R. W. DITCHBURN AND P. J. JUTSUM. Letter in *Nature, Lond.*, **165**, 723–4 (*May* 6, 1950).

535.343

6369. Absorption spectra of tellurides of antimony and bismuth. C. B. SHARMA. Letter in *Curr. Sci.*, **19**, 114 (*April*, 1950).

535.343

6370. Absorption spectra of antimony and bismuth selinides. C. B. SHARMA. Letter in *Curr. Sci.*, **19**, 114–15 (*April*, 1950).

535.343–14

6371. Microwave spectroscopy. D. K. COLES. *Adv. Electronics*, **2**, 299–362 (1950).

A review of developments of the last ten years. A brief survey of the theory of microwave absorption is given, and applications to molecular and nuclear studies are then discussed in detail. There is a section on the width and intensity of absorption lines (12 pages) and another on apparatus and experimental difficulties (19 pages). 92 refs.

535.343–14

6372. A square-wave modulation method for microwave spectra. T. R. HARTZ AND A. VAN DER ZIEL. Letter in *Phys. Rev.*, **78**, 473 (*May* 15, 1950).

535.343–14

6373. Microwave absorption spectra of POF_3. S. J. SENATORE. Letter in *Phys. Rev.*, **78**, 293–4 (*May* 1, 1950).

535.343–15

6374. Infra-red absorption spectra at low temperatures. A. WALSH AND J. B. WILLIS. *J. Chem. Phys.*, **18**, 552–6 (*April*, 1950).

An infrared absorption cell for use at low temperatures is described. Use of the cell requires modification of the optical system of the spectrometer. Spectra of several organic substances which are solid or liquid at room temperature have been recorded and the changes in spectrum on cooling to −170°C observed. The results show that there is a systematic narrowing of infrared absorption bands on cooling from room temperature to −170°. The narrowing reported by previous workers is not of general occurrence but is restricted to certain compounds which undergo a change of state in the temperature range.

535.343–15 : 535.8

6375. Infra-red microspectroscopy. E. R. BLOUT, G. R. BIRD AND D. S. GREY. *J. Opt. Soc. Amer.*, 304–13 (*May*, 1950).

A discussion of the performance characteristics of an infra-red microspectrometer is given in terms of the cross-sectional area and minimum volume, which can be observed with satisfactory signal-to-noise ratio. Methods of increasing the ratio of measured absorption to spectrometer noise are discussed and 5 ways are enumerated. It is pointed out that for a microscope objective of numerical aperture NA_m associated with a spectrometer of numerical aperture NA_s, the useful magnification is $(NA_m)/(NA_s)$. The design of reflecting-type i.r. microscope objectives having numerical apertures up to 1·5 is described. A description of an experimental i.r. microspectrometer is given. Use is made of a commercial spectrometer and conversion from a micro to a macro instrument can be made in a few minutes. In the experimental arrangement no changes were introduced that affected the operation of the spectrometer as a macro instrument. Calculations indicate that by making use of other components now available such as a hotter source and a smaller, more sensitive thermal detector, it will be possible to obtain infra-red spectral measurements of specimens whose linear dimensions approximate those set by diffraction. Examples of i.r. spectra of crystals, fibres and tissues of microscopic area are shown. Comparisons of spectral data with those obtained for macro samples are made and an indication of the experimental limitations of the technique is given.

535.343.2 : 535.5

6376. Absorption bands and luminescence of LiF irradiated at low temperature. P. PRINGSHEIM AND P. YUSTER. Letter in *Phys. Rev.*, **78**, 293 (*May* 1950).

535.343.2–

6377. Infra-red spectrum of hexabromocyclohexane. M. LARNAUDIE. *C.R. Acad. Sci., Paris*, **230**, 1756 (*May* 15, 1950) *In French.*

535.343.4–

6378. The microwave absorption spectrum of methyl alcohol. B. M. GIRDWOOD. *Canad. J. Res.*, **28**, 180–9 (*March*, 1950).

The spectrum was studied in the region 23 400 to 25 200 Mc/sec, using a double modulation system in which the usual radio-frequency sine wave was replaced by a sharp, pip-shaped pulse with a repetition rate of 55 kc/sec. Twenty-five new lines were found and these, along with those previously reported outside the region examined, were grouped into 4 series

...n the CH_3OH was mixed with a large percentage ...water vapour the spectrum was found to be ...fied considerably. A.

535.343.4–14

...**Microwave spectroscopy in the region from ... to three millimeters.** O. R. GILLIAM, C. M. ...SON AND W. GORDY. *Phys. Rev.*, **78**, 140–4 ...*il* 15, 1950).

...completely electronic sweep spectroscope of high ...olution has been developed for the wavelength ...n from 2 to 3 millimeters (150 000 Mc/s to ...000 Mc/s). The radiation source is a Si crystal ...monic generator driven by klystrons. Si crystals ...used also as detectors. Radiation of wavelength ... mm (154 000 Mc/s) has been generated and ...cted with strength more than 10 times the noise ...l. Some lines in the hyperfine structure of the ... $19 \rightarrow 20$ rotational transition of ICN at 2·32 mm ...e been observed. The $J = 1 \rightarrow 2$ transition of ...F has been observed at 2·93, and the separation ...he $K = 1$ and $K = 0$ lines has been determined ...·8 Mc/s. Precision measurements on the first ...tional line ($J = 0 \rightarrow 1$) of $C^{12}O^{16}$ and $C^{13}O^{16}$ in ... 2·6 mm region have been made and molecular ...stants determined. A.

535.343.4–14 : 539.132

...0. Microwave spectra of asymmetric top mole...s. W. J. PIETENPOL, J. D. ROGERS AND D. ...LIAMS. Letter in *Phys. Rev.*, **78**, 480–1 (*May* 15, ...0).

535.343.4–31

...1. Absorption spectra of substances containing ... carbon–iodine bond. I. R. A. DURIE, T. IREDALE ... J. M. S. JARVIE. *J. Chem. Soc.*, 1181–4 (*April*, ...0).

...The ultraviolet absorption spectra of the vapours ...many compounds containing the carbon–iodine ...nd are continuous. This is interpreted in terms of ...oto-dissociation of the C–I linkage. Photochemical ...ctions of iodobenzene and iodoacetic acid support ...s interpretation. New experimental observations ...lude measurements on the absorption spectra of ...obenzene vapour, which confirm the view that the ...ntinuous absorption band obtained in solutions is ...due merely to the influence of the solvent mole...es. Experimental results are also recorded on the ...raviolet absorption spectra of iodoacetic acid, ...ium iodoacetate, ethyl β-iodopropionate, and ...odopropaldehyde. A.

535.345.6

...32. A modified form of the Christiansen filter. ... CARLSEN. Letter in *Nature, Lond.*, **165**, 611 ...*pril* 15, 1950).

...The normal Christiansen filter is, in principle, ...nsparent for all wavelengths, and, while the trans...tted band has a sharply defined maximum, light ...a wide range of wavelengths is still transmitted with ...w intensity. By immersing, in a suitable liquid, ...large number of glass prisms of small angle, all ...nilarly orientated, a filter of greater purity may be ...ade. Using methyl benzoate as the liquid and ...own glass prisms, the filter becomes equivalent to ...normal prism monochromator but has a much ...ger area, greater light intensity, and more dis...rsion than a single prism. R. W. FISH

535.345.6

6383. A simple optical system, with spectral transmission adjustable at will, for heterochromatic photometry or colorimetry. J. TERRIEN. *C.R. Acad. Sci., Paris*, **230**, 1462–3 (*April* 17, 1950) *In French.*

A wedged interference filter has a transmission varying along its length through the entire visible spectrum, so that with a suitable mask over the filter, the spectral energy distribution of the transmitted light can be modified at will. This filter has many uses in photometry in place of a prism monochromator and can be made to give a photocell output conforming to the international visibility curve or to the trichromatic co-ordinates of the incident light. Possible applications are briefly discussed. R. W. FISH

535.37

6384. A model for phosphors sensitized for stimulation. P. BRAUER. *Z. Naturforsch.*, **5a**, 156–8 (*March*, 1950) *In German.*

An energy level scheme is proposed for phosphors sensitized for infrared stimulation. This assumes one impurity activator to have an occupied electron energy state while the other possesses an unoccupied state for electrons. G. F. J. GARLICK

535.37

6385. Theory of the rise of luminescence of phosphors sensitized for infrared stimulation. P. BRAUER. *Z. Naturforsch.*, **5a**, 158–9 (*March*, 1950) *In German.*

Theoretical explanations are given of the rise of luminescence with time when sensitized phosphors are irradiated with infrared radiation. Theoretical calculations are compared with experimental data of other workers [Abstr. 1828 (1949)]. G. F. J. GARLICK

535.371

6386. Distribution of electron traps in the sulphides of zinc and calcium. D. CURIE. *C.R. Acad. Sci., Paris*, **229**, 193–5 (*July* 18, 1949) *In French.*

An attempt to interpret the results of Saddy [*C.R. Acad. Sci., Paris*, **228**, 2022–4 (1949)] in terms of life times, decay curves and trap depth correlations. J. EWLES

535.371

6387. Experimental proofs of electron retrapping in crystalline, phosphorescent sulphides. D. CURIE. *C.R. Acad. Sci., Paris*, **230**, 1400–2 (*April* 12, 1950) *In French.*

By infrared irradiation of phosphorescent sulphides under specific conditions of excitation and temperature the existence of electron retrapping before recombination with luminescence centres is demonstrated. G. F. J. GARLICK

535.371 : 548.0

6388. Remarks on the mechanism of phosphorescence in crystals. D. CURIE. *J. Phys. Radium*, **11**, 179–85 (*April*, 1950) *In French.*

The relative effects of electron trapping, retrapping and recombination with empty luminescence centres on the form of phosphorescence decay in phosphorescent crystals are given quantitative treatment. Discussion of the theory in relation to those of other workers is given. G. F. J. GARLICK

535.371 : 621.3.011.5

6389. Variation of the permittivity and dielectric losses in crystallophosphors under the influence of light. M. Borisov. *C.R. Acad. Bulg. Sci.*, **2**, 33–6 (*April–June, Oct.–Dec.*, 1949) *In Russian.*

The object of the investigation was to separate the two simultaneous variations of permittivity and the h.-f. conductivity of the optically excited crystallophosphor. The conventional method of the frequency reduction of the oscillations of a valve generator by a shunted capacitor containing the specimen under test as a dielectric does not enable the effects to be separated, thus the method of voltage resonance was used for determining the permittivity. The test apparatus was a quartz-stabilized Huth–Kühn circuit, and the detecting circuit (for establishing the resonance) consisted of a silicon detector of constant sensitivity and a galvanometer. The influence of the shunted resistance on the capacitance of the test-capacitor was allowed for by using Jezewski's formula as a correction. The increase of the permittivity of a Cu-activated ZnS, 20% CdS phosphor irradiated by the blue Hg-line was found to be 12%, a much smaller value than the non-separated values found by other authors (up to 55%) by the frequency change method, due doubtless to the "combined effect." B. F. KRAUS (R)

535.372

6390. On the luminescence of phosphors of the aluminium oxide-calcium fluoride type activated with manganese. G. Günther, G. Anderson and H. Perlitz. *Ark. Kemi*, **1**, *Paper* 64, 565–72 (1950).

The best preparations for excitation by 3650 Å contained 20 mol. % CaF_2, 0·04–0·1% Mn, were fired about 1 400°c and had a structure similar to β–Al_2O_3. The emission consisted of an orange-red and an infrared band, both with fairly sharp subsidiary peaks. A similar red emission was shown under 2 537 Å unless the phosphor had been fired in H_2, when whitish luminescence resulted. Cathode-ray excitation gave red emission shifting to the green with increase of Mn or CaF_2, by lower firing temp. or by reduction. S. T. HENDERSON

535.372

6391. Dependence on temperature of the absorption spectra of alkali halide sublimate phosphors activated by thallium. K. V. Shalimova. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 4) 651–3 (1950).

535.372

6392. Two infra-red sensitive SrS phosphors with Zn dominant activator. D. S. Bersis. Letter in *J. Opt. Soc. Amer.*, **40**, 335 (*May*, 1950).

535.372

6393. Variation of emission spectrum of manganese-activated zinc beryllium silicate with decay time. J. H. Schulman, C. C. Klick and R. J. Ginther. Letter in *J. Opt. Soc. Amer.*, **40**, 337–8 (*May*, 1950).

535.372

6394. Luminescence of silica. J. Ewles. Letter in *Nature, Lond.*, **165**, 812–13 (*May* 20, 1950).

535.372 : 535.39

6395. Influence of the external conditions on the absorption and fluorescence of vapours of aromatic compounds. B. S. Neporent. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 1) 35–8 (1950) *In Russian.*

535.372 : 535

6396. Polarization in the luminescence of zirconi I. A. Preobrazhenskiĭ. *Dokl. Akad. Nauk, SS* **71** (*No.* 4) 671 (1950) *In Russian.*

535.372 : 536.48 : 54

6397. The fluorescence of silver halides at l temperatures. II. Mixed crystals of silver halid G. C. Farnell, P. C. Burton and R. Hallam *Phil. Mag.*, **41**, 545–56 (*June*, 1950).

A description is given of the fluorescence emissi spectra. The results are interpreted from a kno ledge of the emission and absorption spectra of t pure halides, and the extents of mixed crystal f mation between them. Some limited results for t temperature-variation of fluorescence efficiency a quoted, which are later shown to be quite compatil with theoretical predictions from a simple mod put forward to explain the general result of pu crystal fluorescence.

535.375.5

6398. Intensity of Raman lines in barytes. P. Narayanan. Letter in *Curr. Sci.*, **19**, 113–14 (*Apr* 1950).

535.3

6399. Quantitative measurements of the bas process of light excitation in luminescent materials single α-particles. I. Broser, H. Kallmann an C. Reuber. *Z. Naturforsch.*, **5a**, 79–85 (*Feb.*, 195 *In German.*

Excitation by α-particles causes in general a ve short fluorescent light surge (exponential fall-tim constant around 10^{-6} sec) followed by a momentar phosphorescence effect. Combined, these may yiel a hyperbolic law for the light output efficiencie against time. Finally genuine phosphorescence ma follow of some minutes' duration, though not easil excited by α-particles. Methods of measuring thes effects by observation of the duration of the ligh surges and estimation of light output efficiencies ar described and results tabulated for: ZnS–Ag, ZnS–C (3 varieties), CdS–Ag, ZnS/ZnSe–Ag, ZnS/CdS–Cu Zn_2SiO_2–Mn, ZnO–Mn, $CaWO_4$, $MgWO_4$, KBr–T and naphthalene. Long after-glow materials exhibi shortest surge duration. The results are of im portance theoretically and for α-particle counters ZnS/CdS–Cu giving best results for quick counter with coincidence circuits. A. SCZANIECK

535.41 : 535.34

6400. Transmittance of interference filters. G. L Buc and E. I. Stearns. Letter in *J. Opt. Soc Amer.*, **40**, 336–7 (*May*, 1950).

535.41

6401. Interference between the two beams emergin from a Lummer–Gehrcke plate. E. Charron an N. Ségard. *C.R. Acad. Sci., Paris*, **230**, 1264 (*March* 27, 1950) *In French.*

In an earlier publication [Abstr. 6931 (1949)] description was given of a type of interference fring exhibited at grazing emergence by the 2 beam coming from opposite faces of a Lummer pla interferometer. The conditions for securing th fringes are improved, 3 methods being describe The fringes can be obtained with white light. The

not formed if the wedge angle between the inter-meter surfaces exceeds 10^{-4} radian.

S. TOLANSKY

535.414

2. A precision method for measuring small phase erences. F. ZERNIKE. *J. Opt. Soc. Amer.*, **40**, -8 (*May*, 1950).

he well-known diffraction figure of 3 equidistant s may be considered as formed by the fringes of al intensity caused by the outer slits, together with coherent background from the middle slit, which rnately reinforces and suppresses these fringes. s effect disappears when the focus of the observing scope is changed so as to cause a geometric path erence of a quarter wave between the middle and er beams, resulting in two accurate settings of drawtube inside and outside focus for which the ges are all of equal brightness. A phase strip in nt of the middle slit gives an outward or inward ft of these settings, which measures its path erence with an accuracy of a few thousandths of a velength. To compensate for the absorption of strip the middle slit is made much wider than the ter slits. The effect is reversed if 2 phase strips are ced in front of the outer slits. By an arrangement h 5 slits, both possibilities may be alternately itched in, thus doubling the precision. The thod is especially valuable for testing larger nples of the material prepared for cutting out the all phase rings to be inserted in microscope jectives. Applications of the same photometric ting to other interference measurements are licated. A.

535.415

03. Light "beats" and light modulation. E. JCHARDT. *Optik*, **6**, 238–44 (*April*, 1950) *In German.*

Experiments giving moving interference fringes ve been interpreted as due to the "beating" of e 2 light beams. This is shown to be false, for the cessary length of wave-train is greater than is nsistent with known radiation damping. For the ysically possible beats obtainable with large quency differences the movement of the inter-rence fringes is too rapid for detection. The eeman and Raman effects can, however, be con-dered correctly as examples of light modulation d beating, although any proof of the coherence of e beat frequency lines is shown to be impossible.

R. W. FISH

535.42

404. A new method of solving diffraction problems. . A. KHARKEVICH. *Dokl. Akad. Nauk, SSSR*, **72** Vo. 1) 45–7 (1950) *In Russian.*

The method is stated to consist, firstly, of the ormulation of any given diffraction problem gionally, with fixed conditions operating at the oundaries of a certain area. The area in question then squared off, the same conditions being pre-erved, and the formulae expressing the relation f the squares to the area are used to make the olution of the subsidiary radiation problem give the equired diffraction solution. A diagram illustrates he operative conditions and formulae are given for 1) the wave equation governing pressure, (2) the type of velocity equation, illustrated by a second diagram, and (3) pressure within the figure for (2). Equation (3) solves the subsidiary radiation problem. Other formulae given cover [(4) and (5)] the conversion of the second diagram to the first. These formulae express an invariant relation to (1). Their combination with (3) obtains the required diffraction problem solution. J. CLEUGH

535.42

6405. A new approximation method for the diffraction by a plane screen. W. BRAUNBEK. *Z. Phys.*, **127** (*No.* 4) 381–90 (1950) *In German.*

The Kirchhoff and more recent methods of treating the diffraction of a scalar wave by a plane screen containing a hole are discussed, and it is noted that none of them are satisfactory when the wavelength is very small compared with the linear dimensions of the hole. For such cases a method is here developed in which the boundary values in the plane of the screen are estimated by using Sommerfeld's exact solution for the case known as the half-plane screen.

P. M. DAVIDSON

535.42

6406. Diffraction by a circular disk. W. BRAUNBEK. *Z. Phys.*, **127** (*No.* 4) 405–15 (1950) *In German.*

The author applies his new approximation method (see preceding Abstr.) to the case of a scalar wave falling on a circular disk, or on a screen with a circular aperture. The results are compared with Bouwkamp's exact treatment of this case [*Diss., Gröningen* (1941)]. The new method gives very simple expressions in the distant field and also at points on the axis; the latter expressions are much more accurate than the Kirchhoff formulae. For the calculation of the transmission coefficient, however, mathematical difficulties prevent the new method from surpassing the Kirchhoff approximation.

P. M. DAVIDSON

535.42

6407. The study of defects in homogeneity by the "shadow" method. M. FRANÇON AND D. WAGNER. *C.R. Acad. Sci., Paris*, **230**, 1850–1 (*May* 22, 1950) *In French.*

The shadow cast upon a screen by a "thread" in a glass plate illuminated by a point source contains diffraction bands. By considering the contrast in these bands, the shadow method is shown to have the same sensitivity as the phase-contrast method using a transparent phase plate. In practice the source should have an apparent diameter of 2 mins of arc when viewed from the glass plate. R. W. FISH

535.42 : 535.14

6408. A determinate corpuscular description of Fraunhofer fringes. M. BOLL. *C.R. Acad. Sci., Paris*, **230**, 1034–5 (*March* 13, 1950) *In French.*

It is shown that Fraunhofer diffraction at an aperture can be explained by postulating a "*champ rectiligne d'impulsions transversales*" acting in the plane of the aperture, and deviating the photons that pass through. An expression is derived for the distribution of the field across the aperture which gives correctly the angles of zero intensity. Photons passing through a given portion of the diffraction

aperture necessarily arrive at a given part of the diffraction field. G. F. LOTHIAN

535.42 : 535.14

6409. A corpuscular and deterministic description of Young's fringes. M. BOLL. *C.R. Acad. Sci., Paris*, **230**, 1144–6 (*March* 20, 1950) *In French.*

A continuation of recent work [see preceding Abstr.]. The fringes are determined by the stationary values of $(k\pi)^{-1} \cos k\pi \exp[-2(1+3k)^{-2}]$. The system considered is a horizontal window placed normally to a beam of photons. The interference and diffraction fringes are studied. L. S. GODDARD

535.42 : 535.14

6410. Comment on the note by M. Boll. L. DE BROGLIE. *C.R. Acad. Sci., Paris*, **230**, 1035–6 (*March* 13, 1950) *In French.*

[See preceding Abstr.]. The author does not subscribe to the views of M. Boll. He is convinced that it is not possible to attribute to a photon a definite trajectory. The solution suggested, while ingenious, will not explain diffraction at a finite distance. G. F. LOTHIAN

535.42 : 535.89

6411. Increasing the accuracy of optical measurements by intensity-minimum specification. H. WOLTER. *Z. Naturforsch.*, **5a**, 139–43 (*March*, 1950) *In German.*

By discussing the diffraction pattern of a slit with an arbitrary distribution of phase across it, it is shown that the principal cause of unsharpness of a light ray may be removed by sacrificing the energy concentration. A plane in space can in principle be characterized with any desired accuracy by suitable minima or weak maxima. In practice the limit is imposed by scattered light, incoherence and the defects of the optical instruments. Various applications are discussed. It is noted that the "path of a ray" can be given a definite meaning by defining it as the locus of the minimum. P. M. DAVIDSON

535.42 : 535.89

6412. Investigations of the ray displacement at total reflection of light, by the method of intensity-minimum specification. H. WOLTER. *Z. Naturforsch.*, **5a**, 143–53 (*March*, 1950) *In German.*

The source of light was designed in accordance with the principles discussed in the previous paper [see preceding Abstr.]. The experiments confirmed the theory and revealed the marked dependence on polarization, not detected by previous experimental workers. P. M. DAVIDSON

535.42 : 536.7

6413. On the thermodynamics of diffraction. G. TORALDO DI FRANCIA. *Atti. Accad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)* **4**, 319–22 (*March*, 1948) *In Italian.*

Using the theory of inverse interference [*Abstr.* 1841 (1949)] it is shown that except for purely theoretical cases diffraction is an irreversible phenomenon.

S. WEINTROUB

535.43

6414. Molecular scattering of light: investigation of the Rayleigh scattering in dilute solutions of electrolytes. R. LOCHET. *C.R. Acad. Sci., Paris*, **230**, 1657–9 (*May* 8, 1950) *In French.*

The light diffused by dilute solutions of isotropic ions is completely polarized; that diffused by anisotropic ions is partly polarized. In 14 out of 1 electrolytes investigated the observed value of th diffusion coefficient led to the correct value for th ratio between M.Wt. and the number of ions p molecule. The exceptions were CdI_2 and $Al_2(SO_4$ and the divergences are attributed to compound ion and hydrolysis respectively. N. CORCORA

535.43

6415. Fine structure of the Rayleigh line amorphous substances. R. S. KRISHNAN. Letter *Nature, Lond.*, **165**, 933–4 (*June* 10, 1950).

By using the λ2536 line, and absorbing the undi placed line in Hg vapour, the Brillouin componen in the light scattered from a rod of fused quart were observed and photographed (exposure 2 days The separation of the components was 1·5 cm (cf. 1·65 calc.).

535.5 : 532.5

6416. Determination of the lines of extinction of weakly birefringent medium by the Bravais biplate application to the Maxwell effect (flow birefringence in solutions of macro-molecules. R. CERF. *Rev. Op (Théor. Instrum)* **29**, 200–4 (*April*, 1950) *In French.*

Details are given of a method by which the line of extinction (cross of isocline) are located to a hig degree of accuracy in a liquid exhibiting the Maxwe effect. The arrangement consists of crossed polarize and analyzer between which is the medium and th biplate. White light illumination is used. Th angle, β, between the optic axis of the biplate and th vibration direction of the polarizer is small. Whe the angle, α, between the extinction direction in th medium and the vibration direction of the polarize is zero the two halves of the bi-plate are equall illuminated. When α is finite the two halves ar differently coloured. The sensitivity is inversel proportional to β and also depends on the brightness B, of the light source. The method has been applie to Sadron's [Abstr. 1646, 3639 (1936)] apparatu with $\beta = 1°$ and $B = 2\,000$ stilb. The method is useful when parasitic depolarized light is present.

H. G. JERRARD

535.5 : 537.533

6417. The selective photo-effect in circularly and elliptically polarized light. S. ZIEMECKI. *Bull. Int Acad. Polonaise Sci. Lett. A.* (*No.* 5–6) 141–6 (*May–June*, 1949).

Details are given of experiments to investigate the variation of the photo-electric emission current with the ellipticity of polarized light for a K–Na alloy. Two experiments were performed. In one, linearly polarized light emerging from a rotatable Nicol was incident on the horizontal surface of the alloy contained in a photo-cell. For a fixed angle of incidence, i, the graph of current against Nicol azimuth was similar in shape to a resonance curve: the maximum occurred when the light vector lay in the plane of incidence. Results are shown for $i = 53·9°$. In the second experiment the light from the Nicol passed through a rotatable $\lambda/4$ plate and then on to the alloy surface. The graph of current against $\lambda/4$ plate azimuth was similar in shape to a sine curve, the minimum occurring for circularly polarized light independent of the direction of rotation. Graphs

given for $i = 53{\cdot}9°$ and $44{\cdot}6°$. The explanation forward is that circularly polarized light produces ory motion of the electron and contributes little he ejection of the particle from the metallic ce. H. G. JERRARD

535.51 : 523.162.1

n polarization of radiation by interstellar medium. *Abstr.* 6206.

535.542.1

. Accurate adjustment of the wedges of a Soleil pensator. H. G. JERRARD. *J. Sci. Instrum.*, **27,** 7 (*June*, 1950).

he appearance of a fringe system instead of com- darkness when the wedges of a Soleil com- ator are placed between crossed Nicols indicates the optic axes in the wedges are not parallel. neral theoretical analysis of the formation of this ge system is given for crossed Nicols and for the where the angle between the vibration directions he Nicols differs slightly from $\frac{1}{2}\pi$. Curves are ted showing the theoretical intensity distribution oss the field of view for selected cases and a com- son made with the case of the wedges of a Babinet pensator. The theory and description of a nd method of observation, in which an image of light source replaces the fringe system, are also n. The effects find a practical use for the adjust- t of the wedges during manufacture of a Soleil pensator. A.

535.55 : 548.0 : 539.32

he elastic and photoelastic constants of fused quartz. *Abstr.* 6766

535.58

9. The dispersion of the molecular optical otropy with wavelength and the Kerr and Cotton–uton effects. R. SERVANT. *J. Phys. Radium*, **11,** –9 (*April*, 1950) *In French.*

After a discussion of the problem and pointing out t studies on the diffusion and depolarization of t by liquids do not give a precise relationship ween the anisotropy and wavelength, a theoretical pression is obtained connecting the anisotropy and refractivity, from which it is shown that the isotropy varies with wavelength in a like manner. e expression is confirmed from figures for quartz d calcite, and for the electric and magnetic bire- ngence of liquids. H. G. JERRARD

535.6 : 537.542 : 535.14.08

.20. Investigation of color centers by a single- oton counting method. A. J. DEKKER AND A. H. ORRISH. Letter in *Phys. Rev.*, **78,** 301 (*May* 1, 1950).

535.65 : 621.327.43

.21. The determination of color parameters of orescent lamps. C. W. JEROME. *Illum Engng, N.Y.*, , 225–32 (*April*, 1950).

A method is evolved for computing the parameters fluorescent lamps for the I.C.I. colour mixture agram from their spectral energy distributions. comparison is made between the values of several mps so measured with their values measured on a filter colorimeter and with values determined by e National Bureau of Standard and Electrical sting Laboratories. A.

535.8 : 535.42 : 771.31

6422. The pin-hole camera. E. W. H. SELWYN. *Photogr. J.*, **90 B,** 47–52 (*March–April*, 1950).

A study, based on the wave theory of light and using simple methods of argument, of the action of the pin-hole camera is presented. It is shown (1) that the pin-hole camera needs to be focused; (2) that the relation between object and image distances is the same as for a thin lens; (3) that it suffers from chromatic aberration, curvature of field and a form of astigmatism. The pin-hole camera, however, is free from distortion under all circumstances. Photographs obtained experimentally are reproduced. A.

535.8 : 535.58 : 539.213

6423. The optical anisotropy and heterogeneity of vitreous silica. C. V. RAMAN. *Proc. Indian Acad. Sci., A*, **31,** 141–8 (*March*, 1950).

The paper describes the birefringence exhibited by vitreous silica, both in the naturally occurring material found in the Libyan desert and in the commercially available material in the forms of rods and disks. The facts revealed by the investigation are discussed. It is shown that Rayleigh's belief that vitreous silica in the mass has a crystalline granular structure cannot be sustained. It is shown further that, besides the familiar stress-optical birefringence, a second kind of effect, viz, "structural birefringence," is also possible in amorphous solids and that this is particularly prominent in vitreous silica for reasons which are discussed. A.

535.82

6424. Phase plate with variable contrast by reflection. M. FRANÇON AND G. NOMARSKI. *C.R. Acad. Sci., Paris*, **230,** 1392–4 (*April* 12, 1950) *In French.*

This apparatus takes the place of the eyepiece in a normal microscope to give images in variable phase contrast. A glass plate is covered with an Al film except for a small central area on which is formed an image of the luminous source, the light being reflected at the polarizing angle. The direct light is polarized and out of phase with the diffracted light reflected by the Al according to the thickness of the film which is adjusted to give $\pi/2$ retardation. A polaroid before the reflector varies the intensity of the direct light and so varies the contrast in the final image. R. W. FISH

535.822

6425. A phase-contrast apparatus, independent of the microscope, using a phase plate of variable absorption. M. FRANÇON AND G. NOMARSKI. *C.R. Acad. Sci., Paris*, **230,** 1050–1 (*March* 13, 1950) *In French.*

The phase-contrast element, which is placed between the object and the microscope objective, is a glass hemisphere with an internal annulus of cryolite upon which an image of the annular source is formed. Light is incident upon the annulus at the polarizing angle and receives a phase change of $\pi/2$ on transmission relative to the diffracted light. The condenser system contains a polaroid screen and a half-wave plate of conical form so that, by relative rotation, the intensity of the direct light reaching the image can be varied within wide limits. R. W. FISH

535.822

6426. Microscope optics. L. V. FOSTER. *J. Opt. Soc. Amer.*, **40,** 275–82 (*May*, 1950).

A brief history of the major advances in microscope

optical designs precedes a description of problems facing the designer and the manufacturer. Recent developments to expand the usefulness of the microscope and to make its effectiveness more nearly approach theory are discussed. Attention is given to the various forms the instrument takes when applied to special fields. A.

535.822 : 537.533.72

6427. Electrons *vs.* photons: a comparison of microscopes. L. MARTON. *J. Opt. Soc. Amer.*, **40**, 269–74 (*May*, 1950).

A comparison of the transmission-type electron microscope with the similar light microscope has to include considerations of the differences in the nature of the carrier of radiant energy and of the optical media used for building up the optical systems. Although electron optics is of relatively recent origin, fairly good agreement of the experimental limits with the theoretically expected ones has been obtained. After a discussion of existing discrepancies, proposals and attempts for improving the performance of the electron microscope are outlined. A.

535.822.9

6428. Experimental and theoretical investigation of the formation of images of non-absorbing objects. H. WOLTER. *Ann. Phys., Lpz.*, **7** (*No.* 1–2) 33–53 (1950) *In German.*

The images of a phase grating and a single phase strip formed by phase contrast and dark ground microscopy or by the Schlieren method are determined by theory and experiment and compared with the objects for dimensions. From photographs of a particularly simple object and the theoretical curves of the intensity distribution, a non-existent structure is shown to appear in the image. The phase contrast method is shown to have the best correspondence between object and image for size. R. W. FISH

535.822.9

6429. The image of cylindrical phase objects of elliptical cross-section. H. WOLTER. *Ann. Phys., Lpz.*, **7** (*No.* 3–4) 147–56 (1950) *In German.*

Many microscopic objects (bacteria, etc.) have an elliptical cross-section and can only be distinguished from their surroundings by the small phase change in the transmitted light. For such cases, the intensity distribution in the image formed by phase-contrast or dark-ground microscopy is calculated as a function of the radius of the object and the resolving power of the objective. The image is shown to be geometrically similar to the object, but with a bright surround to its edge and with the apparent radius in error. For the Schlieren method of observation, the image is not geometrically similar to the object. Experimental confirmation of the phase-contrast results is obtained from photographs of glass fibres. R. W. FISH

535.822.9

6430. Improvements to the image in a Schlieren system by means of the "minimum light condition." H. WOLTER. *Ann. Phys., Lpz.*, **7** (*No.* 3–4) 182–92 (1950) *In German.*

The knife edge of a normal Schlieren arrangement is replaced by a phase plate whose two halves, separated by a straight dividing line, possess 180° phase difference. The Schlieren pattern then maximum definition since the intensity of diffraction image falls to a very sharp minim Photometry of the image, usually necessary accurate work, can be dispensed with as this meth has adequate sensitivity for most purposes. Pract details of the phase plate, its construction and theory of its use are given, together with an act Schlieren photograph showing the increased sensitivi R. W. F

535.82

6431. An extension of Toraldo's theory of ph contrast. I. L. I. EPSTEIN. *J. Opt. Soc. Amer.*, 291–4 (*May*, 1950).

The problem of phase contrast image formati with Köhler illumination is a special case of a m general problem which has been treated by Duffie and his students: The Fraunhofer diffraction patt due to the object is projected upon the phase patte and the diffraction pattern due to the latter constitu the image. A semi-infinite plane covered with uniform, transparent phase-shifting layer is to regarded as a typical microscopic object. The var tion in the appearance of the image as the light g through different portions of the phase annulus examined. The field is darkened on one side of t edge of the object and brightened up on the other si If it is desired that the dark side shall be as dark possible if a large portion of the annulus is filled wi light, a quarter-wave phase shift must be introduc in the phase annulus. For light passing very clo to the edge of the annulus, point-for-point ima formation is no longer rigorously possible. As t annulus is made broader, the contrast becomes le pronounced.

535.822

6432. Phase contrast microscopy for opaque spec mens. J. R. BENFORD AND R. L. SEIDENBERG. *J. Op Soc. Amer.*, **40**, 314–16 (*May*, 1950).

Phase contrast microscopy is by now a famili subject in the field of transmitted light microscop Its application in reflected light is more recen Early systems for reflected light phase contrast eith located the phase annulus directly in the objecti focal plane, or else compromised on this desire location and placed it beyond the vertical illuminato somewhere between aperture and field planes in th microscope. This paper describes a different approac to the problem, resulting in an instrument desig which obviates the elaborate equipments required b the above-mentioned systems, requires only one phas annulus and one illuminating annulus for all objective and in which the phase annulus is located in the ide aperture plane of the microscope.

535.822.

6433. Color phase-contrast microscopy: require ments and applications. C. P. SAYLOR, A. T. BRIC AND F. ZERNIKE. *J. Opt. Soc. Amer.*, **40**, 329–3 (*May*, 1950).

For the use of colour phase contrast in microscop which was first discussed in the spring of 1948, sever difficult requirements must be met for the attainmen of maximum brilliance and usefulness. The syste

If is one in which a controlled chromatism of the use plate is sought instead of the customary control phase difference at one wavelength only. The thickness and dispersion of the phase ring in relation to the neral aperture can be such that zero phase contrast l occur at one or more wavelengths of transition in our sensation. If the phase contrast is made high t opposite in several spectral zones of relatively pure our sensation, striking and beautiful microscopical ages are formed with objects of low inherent contrast. The greatest advantage of the system lies not the beauty of the images, but in the clear distinction ich is afforded between effects caused by scattering general absorption and those caused by small ferences of refractive index or thickness. A.

535.824

34. The theory of image formation in the microope. VIII. M. BEREK. *Optik*, **6**, 219–37 (*April*, 50) *In German.*

Previous results for the intensity distribution in e image of a point object are applied to the case a long, narrow object. The intensity distribution calculated and shown graphically for both bright- d dark-field illumination. This yields an expression r the resolving power of the microscope for 2 such jects lying side by side and for the variation of this solving power with the length of the objects.

R. W. FISH

535.824 : 535.317.25

435. Microscope imagery and interpretations. . OSTERBERG. *J. Opt. Soc. Amer.*, **40**, 295–303 *May*, 1950).

The physical limits of resolution are discussed for e following basic types of object specimens: periodic tructures which exert no focusing action; periodic tructures which do exert focusing action upon the cident light; 2 pin holes or 2 small particles against paque or transmitting backgrounds; 2 narrow slits r object strips against opaque or transmitting backrounds; and 2 sub-microscopic, self-luminous articles. Abbe's theory remains valid as applied to eriodic structures. Generalized resolution formulae re given for periodic structures. Graphical data, ased upon recent analysis, show that the resolution f 2 particles or slits is more complex than indicated y classical theory. The resolving power of the nicroscope is underestimated by the classical theory. Abnormally high resolutions can occur with properly hosen particles. The class of particles for which the hase microscope has superlative resolving power is escribed. A.

535.824.39

6436. The application of white light flash tubes to nstantaneous photomicrography in ordinary or phase-contrast microscopy. M. LAPORTE. *C.R. Acad. Sci., Paris*, **230**, 1592–3 (*May* 3, 1950) *In French.*

The application of the xenon flash tube to photomicrography is discussed and sample photographs shown. The main difficulty to be overcome appears to be the dissipation of the energy for high repetition rates up to 25 per sec. Phase-contrast microscopy requires 5 times the normal energy. R. W. FISH

HEAT 536

536.1

6437. On certain mechanical analogies in the theory of heat. A. DATZEFF. *C.R. Acad. Bulg. Sci.*, **2**, 25–8 (*April–June, Oct.–Dec.*, 1949) *In French.*

A homogeneous bar (the x-axis) has an initial temperature distribution, $u(x, 0)$. The temperature $u(x, t)$ at a subsequent time t is found. A material is now supposed to be distributed along the bar with a density proportional to $u(x, t)$. It is shown that the total mass of this material is constant, and that its centre of gravity is fixed, relative to the time. Various results are also found for the moment of inertia of the mass of material, about an axis through the origin. The results are generalized to 2 and 3 dimensions.

L. S. GODDARD

536.1 : 536.7

6438. Enthalpy and thermal transfer. A. J. O'LEARY. *Amer. J. Phys.*, **18**, 213–21 (*April*, 1950).

The author shows that thermal effects can be described accurately in terms of enthalpy changes, thermal transfer and energy transfer. In this way the descriptions of thermal processes are made precise and the use of terms which arose when heat was considered an indestructible fluid avoided.

F. E. HOARE

536.1 : 537.12

*** The influence of exchange and correlation forces on the specific heat of free electrons in metals.** *See Abstr.* 6467

536.2

6439. The physics of heating of buildings. F. A. VICK. *Sci. Progr.*, **38**, 283–9 (*April*, 1950).

A précis is given of a series of papers in *Trans. Danish Acad. Tech. Sci.* (*No.* 4) (1947) by F. C. Becker and N. F. Bisgaard.

536.2

6440. Application of the membrane analogy to the solution of heat-conduction problems. L. H. WILSON AND A. J. MILES. *J. Appl. Phys.*, **21**, 532–5 (*June*, 1950).

Establishes the feasibility of applying the analogy to 2-dimensional steady-state problems. The analogy is established, and the construction and the use of the apparatus for measuring the film are described. Inexpensive apparatus and simplicity of execution are the predominating features. A.

536.2 : 533.15

Optical quantitative method of observation of thermal and diffusion phenomena in plane conditions with small deformations of approximately plane surfaces (grid method). *See Abstr.* 6298

536.2 : 538.63 : 538.66 : 537.311

Thermal conduction of single crystals of bismuth in transverse magnetic fields. *See Abstr.* 6489

536.21

6441. Heat conduction in a melting solid. H. G. LANDAU. *Quart. J. Appl. Math.*, **8**, 81–94 (*April*, 1950).

The general problem is stated and a formula for the temperature distribution is obtained. The liquid formed by melting is removed immediately on formation. In the case of a semi-infinite melting solid with

its face heated at a constant rate, the exact steady state solution is obtained. Only a single parameter is involved. Numerical integration is carried out for several values of the parameter. L. S. GODDARD

536.24

6442. On the general linear problem of the flow of heat in a medium consisting of several layers. A. DATZEFF. *C.R. Acad. Bulg. Sci.*, **2**, 21–4 (*April–June, Oct.–Dec.*, 1949) *In French.*

The layers are bounded by parallel planes. The problem is formulated mathematically and solved, in principle. The result is complicated since it involves the solution of a set of simultaneous integral equations of the Volterra type. L. S. GODDARD

536.24

6443. The derivation of a "content-function" from an associative function and the formation of physical concepts. H. NIEHRS. *Z. Phys.*, **127** (*No.* 3) 187–93 (1950) *In German.*

The main result of this paper is incorporated in the following theorem. Two substances are each specified by their temperatures (x_0, y_0) and n other temperature-independent constants $(x_j, y_j; j = 1, 2, \ldots n)$. As a result of heat exchange, neglecting other influences, one obtains the $n + 1$ corresponding quantities

$$v_i = f_i(x_0, \ldots, x_n;\ y_0, \ldots y_n);\ i = 0, 1, \ldots n,$$

or, briefly, $V = f(X, Y)$. This type of multiplication is commutative and associative, and the equation $f_0(T, x_1, \ldots, x_n; T, y_1, \ldots y_n) = T$ holds. From these relations it is shown that a function $W(x_0, x_1, \ldots x_n)$, or, briefly, $W(X)$, exists such that $W(X) + W(Y) = W[f(X, Y)]$. W is related to the heat content. The main application which is intended is to heat exchange, but other applications are also discussed.

P. T. LANDSBERG

536.41 : 548.7

Thermal expansion in silver halides. *See Abstr.* 6827

536.42

6444. A relationship between the alteration of the melting point and the difference of the specific heats in melting for some metallic elements. K. HONDA AND M. SATO. *J. Sci. Res. Inst. Tokyo* (*No.* 1223–6) 114–15 (*Jan.*, 1950) *In German.*

The change of melting point pressure with temperature is related to the difference of specific heats in liquid and solid form. Numerical results are considered for Na, K, Pb. F. E. HOARE

536.421.4

6445. On the freezing-out of vapours from gas-vapour mixtures at atmospheric pressure. H. LINDE. *Z. angew. Phys.*, **2** (*No.* 2) 49–59 (1950) *In German.*

A new and extended form of apparatus, which is described and illustrated, was used to continue R. Hilz's experiments [*Z. ges. Kälteind.*, **47**, 34–7, 74–8, 88–92 (1940)]. The 6 mixtures, water-vapour/air, water-vapour/H_2, water-vapour/CO_2, C_6H_6/N_2, C_6H_6/H_2, C_6H_6/CO_2 were examined. The binary gas mixture is passed through a tube which is cooled below the freezing point of one of the components and this component is deposited on the walls of the tube as snow. The snow may adhere to the tube wall or may be formed in the gas, falling from the wall on account of its own weight and the movement of the gas. Turbulent flow produces a thick layer of sno and large portions are only seldom torn off. The g and cooling liquid temps., and the humidities, entry to and exit from the cooling region, and th speed of flow of the gas, were measured. A con parison between the measured mean Nusselt numbe and the theoretical values for CO_2, air and H_2, f range of Re from 0–5 000 is shown graphically. quantity $\psi = (f_0 - f_{1m})/(f_0 - f'_{1m})$, where f_0, f_{1m} a the mean humidities at entry to and exit from th cooling region and f'_{1m} the saturation humidi corresponding to the mean exit temp., is defined as measure of the freezing-out on the wall. For tu bulent flow ψ is close to 1, denoting that so much the vapour component is frozen out that the mixtu leaves the cooling region saturated. For laminar flo the conditions are not so clear. The formation an adherence of the snow on the wall in relation to th ψ-values for the various mixtures are discussed.

S. WEINTROU

536.421

6446. Some observations on ice and the processes connected with its formation. N. YA. SELYAKOV *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 5) 821–4 (1950) *In Russian.*

Ice crystals formed naturally in the Vologda rive and made in the laboratory were examined by thre different methods to give information on their siz and their orientation to the freezing surface. It wa established that the size of the crystals in lumps o ice taken from the lower transparent part of the rive in deep places, and made artificially, was of the orde of several cm in diameter. The general character o the orientation of the ice crystals was shown t confirm that natural ice has an acicular structure A method of "figures of melting" proposed b Tyndall was developed in which images of the crystal could be thrown on a screen and the so-called ic colours with an axis of symmetry of the 6th orde observed. It was found that in addition to figure of melting with axis of symmetry of the 6th orde figures were obtained of both oval and circular form This indicates that the majority of ice crystals are orientated so that their bases are parallel to the wate surface, but that perpendicular orientation also occurs Mechanical breakdown of the crystals with an iron pick showed the existence of one or two surfaces o fracture either parallel or perpendicular to the surface Two methods are described for freezing water in such a way that the pressure developed during freezing from an open surface can be eliminated, and the method of crystal formation using these techniques discussed. Evaporation from a frozen surface was also investigated. W. HUGHES

536.424 : 532.7 : 541.64

6447. Second-order transition temperatures and related properties of polystyrene. I. Influence of molecular weight. T. G. FOX, JR., AND P. J. FLORY. *J. Appl. Phys.*, **21**, 581–91 (*June*, 1950).

Dilatometric and viscometric data on fractionated polystyrenes containing diethylbenzene end groups are presented over wide temperature ranges. The second-order transition temperature, viscosity-temperature coefficient, and specific volume all change rapidly with increasing molecular weight toward

nptotic limits which are practically reached at $\simeq 30\,000$. Empirical expressions are presented ting these properties to molecular weight and nperature. In each case the dependence on mole- ar weight is expressed as a simple function of $^{-1}$. These observations are interpreted and corre- d on the basis of the hypothesis that the local nfigurational order in a liquid polymer is disturbed the introduction of end groups to a degree that proportional to their number. The second-order nsition does not represent an isoviscous state. e internal local configurational structure appears to equivalent, and independent of temperature, in all lystyrenes below their second-order transition nperatures. A.

536.46 : 537.566

448. Ionization and luminescence in flames. E. ENGER, I. BREDT AND P. GŒRCKE. *C.R. Acad. i., Paris*, **230**, 949–51 (*March* 6, 1950) *In French*; *angew. Math. Phys.*, **1** (*No.* 3) 209–11 (1950) *In erman.*

The no. of molecular collisions needed to set up ermal equilibrium in a gas differs greatly among the rious degrees of freedom. Translational equilibrium attained after about 10 collisions per molecule, t, because recombination is a comparatively rare currence, each molecule must undergo about 10^9 llisions before ionizational equilibrium is set up. ear a flame front, therefore, nearly all the energy berated by chemical reaction is at first absorbed the translational degrees of freedom. At this age, the molecular velocities are abnormally high, nd many molecules will possess energies high ough to produce ionization and electronic excitation n collision. The ionization will persist until at a uch later stage complete thermodynamic equilibrium set up. It is suggested the delay in reaching equili- rium among the higher degrees of freedom is sponsible for the high ionization and luminescence f flames. A. SCHOFIELD

536.48

449. Some properties of solutions of He^3 in He^4. . N. ESELSON AND B. G. LAZAREV. *Dokl. Akad. auk, SSSR*, **72** (*No.* 2) 265–7 (1950) *In Russian.*

About 20 cm^3 of He^4 gas containing up to 1·5% He^3 as prepared from well helium by using the thermo- echanical effect in liquid He II to give an enrichment f 10^3 followed by an enrichment of 200 in a thermal iffusion column. Studies of the liquid helium film ow showed that the λ-point was depressed at a rate f 1·3° K per unit concentration of He^3. It is con- idered that this is a more reliable result than the °K per unit concentration found by Abraham, einstock and Osborne [Abstr. 1718 (1950)]. Some eculiarities in the film flow of the 1·5% solution are ttributed to complications caused by differences of oncentration of He^3 in the two vessels between hich the film is flowing. It was shown in the ourse of further enrichment experiments starting ith the 1·5% mixture that He II containing 30% He^3 ould still exist at 1·4°K. D. SHOENBERG

536.48 : 532.13

450. The viscosity of liquid He^3. R. A. BUCKINGHAM AND H. N. V. TEMPERLEY. Letter in *Phys. Rev.*, **78**, 482 (*May* 15, 1950).

536.48 : 534.21

6451. Absorption of sound in helium II. I. M. KHALATNIKOV. *J. Exp. Theor. Phys., USSR*, **20**, 243–66 (*March*, 1950) *In Russian.*

A detailed theory of the absorption of first and second sound in liquid He II associated with the relatively slow processes of emission and absorption of elementary excitations (phonons and rotons) is developed. The theoretical parameters determining the rates of these processes are estimated by comparison with the experimental data of Pellam and Squire [Abstr. 885. (1948)] on the absorption of first sound. Curves are given of the predicted temperature variation of α_1/ω^2 and α_2/ω^2 (α_1 and α_2 are absorption coefficients for first and second sound in cm^{-1}, ω is the angular frequency): α_1/ω^2 varies from $\sim 2\times10^{-17}$ at 2·0°K to $\sim 10^{-15}$ at 1·0°K, α_2/ω^2 varies from $\sim 2\times10^{-14}$ at 2·0°K to $\sim 2\times10^{-11}$ at 1·0°K. D. SHOENBERG

536.48 : 534.61

6452. The thermal Rayleigh disk in liquid helium II. J. R. PELLAM AND P. M. MORSE. Letter in *Phys. Rev.*, **18**, 474–5 (*May* 15, 1950).

A thin disk suspended vertically in a second sound field with its plane at 45° to the axis of wave propagation was found to have a couple acting on it, which was in good agreement with the classical formula for a Rayleigh disk, if it was assumed that both components of the liquid He II (2-fluid hypothesis) contribute to the couple. D. SHOENBERG

536.48 : 536.2

6453. Measurements on the thermal conductivity and thermomechanical effect of liquid helium II. G. DUYCKAERTS. *Mem. Soc. Roy. Sci., Liège*, **1** (*No.* 2) 347–99 (1943) *In French.*

A study of these quantities in capillaries of less than 0·3 mm diameter. The main conclusions are: (1) if account is taken of the difference in vapour pressure between the two baths used in the experiment, the fountain effect is always positive; (2) London's formula for the fountain effect, $dp/dT = \rho S$, is verified provided the temperature difference is sufficiently small; (3) the heat current is proportional to the temperature difference if this is sufficiently small; (4) the higher the temperature and the wider the capillary, the smaller the temperature difference necessary for (3) and (4); (5) at a given temperature, the fountain effect is always proportional to the heat current. R. B. DINGLE

536.48 : 536.421.4

6454. The liquid-solid transition in helium near absolute zero. F. E. SIMON AND C. A. SWENSON. *Nature, Lond.*, **165**, 829–31 (*May* 27, 1950).

Measurements of the melting pressure and volume difference between liquid and solid He show that below 1·72° the energy of the liquid < that of the solid. R. B. DINGLE

536.48 : 536.7

6455. Thermodynamics of He^3–He^4 solutions. O. K. RICE AND O. G. ENGEL. Letter in *Phys. Rev.*, **78**, 183 (*April* 15, 1950).

It is pointed out that views on mixtures of He^3 and He^4 recently expressed by Gorter and de Boer [Abstr. 4024 (1950)] are in accordance with those of

Rice [Abstr. 2417, 3123 (1950)] except in one particular. An expression is deduced for the Gibbs free energy of a mixture and the method of obtaining the partial vapour pressures of He^3 and He^4 outlined for a "quasi ideal" solution. Suggestions of the type of modification necessary, if deviations are found to occur, are made. F. E. HOARE

536.5 : 537.324 : 621.392.52

6456. A high-frequency current filter in a thermo-electric circuit for temperature measurement. C. L. M. COTTRELL, J. G. PURCHAS AND K. WINTERTON. Letter in *Nature, Lond.*, **165**, 857–8 (*May* 27, 1950).

536.5.081 : 535.23

6457. The optical temperature scale and the radiation constants. F. HOFFMANN. *Z. angew. Phys.*, **2** (*No.* 2) 88–95 (1950) *In German.*

A detailed review of the experimental data on which the correlation of the optical pyrometer and gas thermometer scales is based. The decision of the 1948 Bureau International Wts. and Measures Paris Conference to introduce a new optical scale by fixing the Au-point at 1·063°C and $c_2 = 1{\cdot}438$ cm. deg. is criticized. The effects of errors in the determination of c_2 and the Au-point are considered, and it is concluded that a pyrometric determination of the Au-point with reference to a lower fixed point which is well defined on the gas thermometer scale would be of value. A considerable improvement would be to base the optical scale on both c_2 and σ, the total radiation constant. S. WEINTROUB

536.521 : 537.312.5

6458. Low-temperature radiation pyrometry using a lead sulphide photoconductive cell. C. R. BARBER AND E. C. PYATT. Letter in *Nature, Lond.*, **165**, 691–2 (*April* 29, 1950).

536.532

6459. The measurement of gas temperature by thermocouples. R. JACKSON. *B.C.U.R.A. Bull.*, **14**, 33–9 (*Feb.*, 1950).

A review. The disadvantages of, and the errors introduced by, probes are discussed. The plain thermocouple, the use of radiation shields, the suction pyrometer, and the suction pyrometer with radiation shields are treated separately. 30 references.

S. WEINTROUB

536.631 : 536.48

6460. Specific heat anomalies of germanium and hafnium at low temperatures. P. AIGRAIN AND C. DUGAS. *C.R. Acad. Sci., Paris*, **230**, 1277–8 (*March* 27, 1950) *In French.*

It is assumed that these anomalies are due to the excitation of electrons from impurity levels to the conduction band. Taking (from other evidence) a value 0·03 eV for the excitation energy, it is estimated that there are 10^{19} impurity levels per cm^3 in Ge.

R. B. DINGLE

536.632

6461. Measurement of the specific heat of liquids by cooling in an air stream. A. R. INGLES. *Amer. J. Phys.*, **18**, 194–9 (*April*, 1950).

A student experiment. Two similar calorimeters are mounted near exit ports in an enclosure, so that they can be cooled by streams of air from a centrally placed blower. One is filled with water, the other with the liquid to be investigated. A cooling curv can be measured in ~ 12 minutes, so that sever determinations are possible in an ordinary laborato period. The exponent in the cooling-curve law found to be 1·20–1·25, which is very nearly th same as is found for cooling by free convection.

A. J. C. WILSO

536.632 : 536.76

6462. On peculiarities in the temperature-dependenc of the heat capacity of liquids and on the nature of th phase transformations of the second kind. S. URAZOVSKIĬ AND I. A. SIDOROV. *Dokl. Akad. Nauk SSSR*, **70** (*No.* 5) 859–62 (1950) *In Russian.*

See also Abstr. 1616 (1950). An adiabati calorimeter with a high-vacuum jacket, a precisio electric heating element and a Pt resistance thermo meter were used. The accuracy was 0·001°C. Th heat capacity was determined to 1%. Obviou anomalies have been found in the C_p/t curves, viz sharp peaks near 51°, 57° and 61°C for undercoole liquid monochloracetic acid. These anomalie correspond to those found in the measurements o surface tension, and the respective temperatur ranges coincide (within 1°C) with the melting-point of the monotropic-polymorphous modifications o the substance tested. F. LACHMA

536.633 : 536.76

6463. Note on the specific heat of liquid-vapou mixtures. L. GOLDSTEIN. *J. Wash. Acad. Sci.*, **40** 97–101 (*April* 15, 1950).

Expressions are derived for c_v, the specific heat a constant volume of the mixture, and for Δc_v the dis continuity in crossing the vapour or liquid saturation line. For transitions across the vapour saturation curve $\Delta c_v < 0$ ($v > v_c$) where v_c is the critical volume and for transitions across the liquid saturation curve $\Delta c_v > 0$ ($v < v_c$). At the same temperature T the numerical values of the Δc_v's in the two cases differ considerably, the first > the second. The variation of c_v with temperature along the constant volume lines for 100, 120 and 140°C in the liquid-vapour mixed phase and along the vapour saturation line is computed and shown graphically for water. It is stated that the expressions derived have been verified experimentally by the author for water at several temperatures between 100 and 180°C, and that this constitutes a direct verification of the Ehrenfest formulas. S. WEINTROUB

THERMODYNAMICS 536.7/.8

536.7 : 536.652 : 53.081.1

6464. The length thermodynamically defined by the latent heat of fusion and quantities derived from it. L. LABOCCETTA. *Atti. Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **4**, 322–6 (*March*, 1948) *In Italian.*

In terms of the latent heat C, the density Δ and gravitational constant k, the length $R = (5CJ/4\pi\Delta k)^{\frac{1}{2}}$, mass $M = 4\pi R^3\Delta/3$, and time $T = (5/8\pi\Delta k)^{\frac{1}{2}}$ are deduced, where J is the mechanical equivalent of heat. Water is considered as a numerical example.

S. WEINTROUB

536.7 : 538.669

ermodynamics of transverse thermomagnetic ts. *See Abstr.* 6665.

536.71 : 539.11 : 541.64

. Transitions in high-polymeric materials. R. EDAHL AND L. E. NIELSEN. *J. Appl. Phys.*, **21**, 7 (*June*, 1950).

ne evidence for and against the interpretation of "second-order" transition in polymers in terms thermodynamic transition of the second order eviewed and some new experimental data con- ing transition in mixtures of polymers are pre- ed. It is shown that the relaxation theory is fficient to explain the transition, as observed by hanical, electrical and thermal measurements. usual objections which are raised against the mption of a thermodynamic transition are shown e invalid. Various molecular processes responsible a thermodynamic transition are discussed and it nown that the general mechanism of "hindered" ation (changes in rotational configuration) is the st likely. A.

536.74 : 536.48

6. A thermodynamic temperature of 1·5 millidegrees absolute. D. DE KLERK, M. J. STEENLAND AND C. J. GORTER. Letter in *Phys. Rev.*, **78**, 476 (*May* 15, 1950).

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.12 : 536.1

57. The influence of exchange and correlation ces on the specific heat of free electrons in metals. P. WOHLFARTH. *Phil. Mag.*, **41**, 534–42 (*June*, 50).

The effect on specific heat of including exchange ms in the expression for the electronic energy of a e electron gas is discussed. Previous work is nsidered; the only full discussion (Koppe 1947) ntains a number of algebraical errors. When these e corrected the theoretical expression for specific at becomes, for Na, $C_e = \gamma T/(8{\cdot}9 - 1{\cdot}7 \log_{10} T)$, er a wide temperature range, γ being the Sommerld factor. This relation is in disagreement with servation, due to the approximation implied in e use of a one-electron wave function. Landsberg's ntative suggestion (1949) for estimating the effects correlation forces is considered in relation to the resent problem, a screened rather than a simple oulomb potential being used in the exchange tegral. The value of the screening constant required restore approximate agreement with observed ecific heats is found to be of the same order of agnitude as that derived from the soft X-ray mission spectrum. A.

537.133 : 778.3

The photographic effect of medium fast protons. *ee Abstr.* 693

ELECTROSTATICS . DIELECTRICS 537.2

537.21 : 621.317.723

6468. Design of vibrating capacitor electrometer. H. REESE, JR. *Nucleonics*, **6**, 40–5 (*March*, 1950).

A vibrating capacitor operating at 60 c/s converts a d.c. input into 60 c/s a.c. The input current produces a potential drop across a resistor ($\sim 10^{10}\ \Omega$) and the difference between this potential and a balancing potential (controlled by the output) is applied to the vibrating capacitor, through a high resistance. The balancing potential is produced across a sliding wire potentiometer driven by a 2-phase motor, operating on the amplified output of the electrometer, which also drives the current recording indicator. The signal from the capacitor feeds into a preamplifier followed by a 4-stage a.c. amplifier. Currents as low as 10^{-15} amp. can be detected. One cause of instability is variation in the work function difference between the two surfaces of the capacitor, but this can be reduced to small proportions by the use of Au or Rh plating. The stability of the servo system is discussed and it is shown that the system can be damped by a suitable capacity placed across the input resistor.

L. R. SHEPHERD

537.212 : 621.3.011.5 : 621.315.61

6469. Electric fields in anisotropic media. A. V. NETUSHIL. *Elektrichestvo* (*No.* 3) 9–19 (1950) *In Russian.*

The theory is developed with special regard to the various kinds of non-homogeneous insulating materials used in electrical engineering, whose structure permits their subdivision into two main classes, those of linear and curvilinear anisotropy; the special axial or cylindrical case of the latter is considered. The condition enabling a point transformation to reduce the anisotropic case to the corresponding isotropic one is derived. Problems involving plane-parallel fields in anisotropic media are considered. The special method derived is termed "isotropizing deformation" and consists, in the linear case, in a projection along the co-ordinate axes concerned of the quantity $\sqrt{\varepsilon_i}$, where ε_i is the permittivity along the axis. B. F. KRAUS (R)

537.212 : 621.317.723

6470. An electrostatic fluxmeter of short response-time for use in studies of transient field-changes. D. J. MALAN AND B. F. J. SCHONLAND. *Proc. Phys. Soc., Lond. B*, **63**, 402–8 (*June*, 1950).

The fluxmeter consists of a conducting system of small capacity which is alternately exposed to and screened from the electric field by the movement of a rapidly rotating metal shield, thus producing an alternating E.M.F. of period 0·83 m sec. The output, after amplification, is displayed on the screen of a cathode-ray oscillograph and the record carries an automatic indication of the sense of the field every 7·5 m sec. At the maximum sensitivity employed the device gives a deflection of 1 cm in a field of 20 V/m, with a background noise-level of 0·15 cm (3 V/m). The response-time of the instrument is 1 half-cycle (0·42 m sec.). The fluxmeter has been developed to give the rapid response and high sensitivity required for studies of the electric

fields of thunderstorms in the intervals between the separate strokes of a lightning discharge. A.

537.213 : 621.317.727

6471. An electron tube potentiometer method for use in circuits involving very high resistance. H. BLOOM AND G. W. BUTLER. *Rev. Sci. Instrum.*, **21**, 724–5 (*April*, 1950).

The construction and use of an electron tube potentiometer for circuits involving resistances of the order of 100 mΩ are described.

537.226

6472. The time involved in fast electronic processes in amorphous dielectrics. *Rep. Brit. Elect. Res. Ass.* (*Ref. L/T220*) 2 *pp* (1949).

A theoretical discussion is given for the times of processes which involve only electrons in the conduction levels and in shallow traps of an amorphous dielectric in the presence of an electric field. A simple model is considered in which there is a conduction band and a series of equispaced impurity levels below it. The processes considered are then found to be sensibly complete in a time of 10^{-10} sec or less. A.

537.226

6473. Properties of slow electrons in polar materials. *Rep. Brit. Elect. Res. Ass.* (*Ref. L/T221*) 12 *pp.* (1950).

The properties of the lowest energy levels in a range $\hbar\omega$ above the ground level of the system consisting of an electron and a continuous dielectric medium have been investigated using a variational method. The latter is supposed to have a single vibrational frequency $\omega/2\pi$ for long longitudinal polarization waves. The interaction between the electron and the medium then depends on 3 parameters, the static dielectric constant ε, the optical refractive index $\sqrt{\varepsilon_\infty}$, and ω. The replacement of a crystalline lattice by a continuum is a good approximation if the length $b = (\hbar/2m\omega)^{\frac{1}{2}}$ is large compared with the lattice distance, a condition which is usually fulfilled. It is found that the energy of the ground level may be considerably (compared with $\hbar\omega$) < the energy which the system would have in the absence of interaction. The electron can be found with equal probability at any point in the medium. The average polarization of the medium therefore vanishes at any point. This does not hold, however, for the average polarization at a given distance from the electron. This quantity varies as the polarization of a point charge, but shows deviations below distances of the order b. The energy of interaction depends very little on the average velocity of the electron. Slow electrons, therefore, behave very similarly to free electrons. It follows that self trapping in the lattice—a suggestion which has often been discussed—does not exist. A.

537.226 : 537.529

6474. Time dependence of electronic processes in dielectrics. H. FRÖHLICH AND J. O'DWYER. *Rep. Brit. Elect. Res. Ass.* (*Ref. L/T219*) 4–8 (1949).

Dielectrics are considered at temperatures sufficiently high to put them into the so-called high temperature region of dielectric breakdown (where their temperature characteristics are negative). At room temperature amorphous substances are usually in this region while crystalline materials are not. On this basis the fundamental equations describi time-dependent electronic processes are derived. particular the following are investigated theoretical (i) The time required to obtain stationary conditio in the absence of a field after an ionizing radiati has been acting on the substance; and the way which the absorbed energy is converted into he (ii) The field and time dependence of the electron current in a strong field. It appears that in son substances the electronic current may increase w time over periods longer than the usual times observation. (iii) The time required to initia breakdown in a sufficiently strong field. (iv) T time required to obtain stationary conditions in t presence of a field after an ionizing radiation h been acting on the substance. We find that t possibility of a breakdown exists for field strength which is smaller than the normal breakdown fi strength by a factor between 10 and 100.

537.226.08 : 621.335.2 : 621.317.7

6475. Developments in bridge methods for dielect measurements. T. GAST. *Z. angew. Phys.*, **2** (*No.* 41–8 (1950) *In German.*

Describes an a.c. bridge method for measuremen of capacitance and power factor between 50 c/s a 2 Mc/s, with automatic balancing arrangements a an electrostatic detector system. [See *Z. Naturforsc* **2a**, 344–8 (*June*, 1947)]. E. RUSHTON (

537.226

6476. Measurement of the optical constants of pol liquids in the microwave region. R. HONERJÄGER A W. MECKBACH. *Z. Phys.*, **127** (*No.* 4) 357–62 (195 *In German.*

A waveguide is filled with a mixture of ethyl alcoh and water, and the refractive index (n) and absorptic coeff. (nk) measured by classical methods (λ = 9·95 cm in air). There is a minimum of nk at 35° while n increases steadily with temp. from 0 to 70° and decreases with alcohol content. Extrapolate results for 100% alcohol agree fairly well with Bä and Slevogt, who do not state conc. of alcohol used. N. CORCORA

537.226

6477. On the dielectric properties of HBr and DB in the liquid and solid states. J. G. POWLES. *C.R. Acad. Sci., Paris*, **230**, 836–8 (*Feb.* 27, 1950) *In Frenc*

Dielectric constant and loss measurements wer made from 80 c/s to 15 Mc/s and 80°A to 140°A At 80 c/s for HBr a discontinuity in ε'' is found a 115°A and a strong maximum at 90°A, which tem peratures correspond to specific heat anomalies. A high frequencies two dispersion regions appear, th major at 1–100 kc/s vanishes abruptly above 90° and there is a minor region about 1 Mc/s. Above 90 the dispersion all occurs above 10 Mc/s. DBr i similar. D. H. WHIFFE

537.226

6478. Dielectric constant of quartz at the α–β transformation point. J.-P. PÉREZ. *C.R. Acad. Sci Paris*, **230**, 932–3 (*March* 6, 1950) *In French.*

The α–β transformation in quartz is accompanie by changes in the capacitance-temperature curv between 500° and 600°c. There are various form which the changes may take in different sample

a discontinuity in the capacitance-temperature e at about 550°C, the capacitance value decreasing ply and the capacitance-temperature curve having rent slopes above and below 550°C; (2) a constant citance with temperature between 500° and 600°C; (3) an increase in capacitance between 500° and C, the rate of increase being only slightly different n that occurring below 500° and above 600°C.

E. RUSHTON

537.226.2

). **Dielectric constants of alumina.** D. A. A. S. AYANA RAO. Letter in *Curr. Sci.*, **19**, 119 (*April*,)).

537.226.2

). **The dielectric constants of water, hydrogen oxide and hydrogen peroxide–water mixtures.** M. GROSS, JR. AND R. C. TAYLOR. *J. Amer. m. Soc.*, **72**, 2075–80 (*May*, 1950).

he dielectric constants of aqueous H_2O_2 solutions e been measured in the concentration range from o to 99·2% H_2O_2 and for temperatures ranging n 30° to approximately −65°. The dielectric stant of pure H_2O_2 is found to be less than that of er at all temperatures for which they are compared. e measurements, which are of moderate precision, iate rather markedly from those previously reported 0°. The dielectric constant-composition isotherms aqueous H_2O_2 solutions all exhibit a broad maxi- m at intermediate concentrations. This maximum comes more pronounced and appears progressively higher peroxide concentrations as the temperature owered. A.

537.226.2 : 539.32 : 548.0

Dielectric constants of uniaxial crystals. *See str.* 6822

537.226.2 : 621.315.61

31. Superpolarizable (ferroelectric) materials. E. RANIER. *Rev. Gén. Elect.*, **59**, 33–45 (*Jan.*, 1950) *French.*

The nature of electronic, ionic and dipolar polariza- ns is discussed. All these are very much less than e polarization occurring in ferroelectric crystals ch as Rochelle salt. While the permittivity, ε, of ch materials is always high, in a narrow temperature nd it becomes of the order of 10^4. The upper and wer edges of the band are well-defined and are nown as the Curie points. Between the Curie ints the loss tangent increases greatly, particularly mm-wavelengths. The magnitude of ε' is dependent on the orientation of the crystal axes with respect the applied field. The quantity $1/\varepsilon'$ varies with mperature in the same way as magnetic susceptiility and obeys the Curie–Weiss law. It is shown at the ferroelectric effect obeys the same laws as rromagnetism, and the ferroelectric crystals show ectrical hysteresis and a counterpart of the Barkausen effect. A difference between the ferromagnetic nd ferroelectric effects lies in the size of the domains. n the latter they are large, of the order of 0·01–·0 cm. Their presence can be observed, and their ze estimated from X-ray, supersonic and lycopodium studies. Owing to the large size of the omains, the reversal of the sign of a single domain an produce a detectable kink in a hysteresis curve. he ferroelectric crystals have piezoelectric properties which show the same anomalies as their dielectric properties. Both are explained in terms of crystal structure. The industrial applications of these materials is discussed. W. T. BLACKBAND (R)

537.226.31

6482. Dielectric relaxation investigations on the question of the internal field and of the characterization of associated and non-associated dipolar liquids. E. FISCHER. *Z. Phys.*, **127**, (*No.* 1–2) 49–71 (1950) *In German.*

Dielectric loss measurements near 60 Mc/s by the "thermometer" method for chlorbenzene, nitrobenzene, alcohols, water and other liquids, lead to estimates of the relaxation times from 20 to 50°C. These are discussed and are shown to agree with predictions using the relaxation times in benzene solution, the relative viscosities and the Onsager field theory, although with alcohols the observed times are too long since H bond association is important.

D. H. WHIFFEN

537.226.8 : 536.63 : 548.7 : 536.424.1

Dielectric constants of solid alkyl halides. *See Abstr.* 5768

537.226.8 : 621.315.61.011.5 : 621.38

6483. Random noise in dielectric materials. R. F. BOYER. *J. Appl. Phys.*, **21**, 469–77 (*June*, 1950).

When thin films of polar plastic materials are subjected to d.c. potentials of 10 to 300 V/mil they exhibit current fluctuations (with frequencies in the range of 60 to 1 000 c/s) which last for minutes and which even persist for a few seconds on removing the voltage. These fluctuations are about 1 000-fold above the noise level of the circuit and are about 1% of the steady d.c. current. They eventually die out but can usually be restored by reversing the polarity. This noise is greater the more polar the nature of the polymer and the higher its moisture content. The effect seems to arise from water or impurity ions which can jump whenever a hole opens between polymer chains and is thus an activated rate process sufficiently slowed down by the highly viscous nature of the polymeric medium to be readily observable. On an oscillograph screen it is possible to see both the forward and the backward diffusion. This noise is most pronounced in Cellophane, Nylon and copolymers of vinylidene chloride with acrylonitrile, but also appears with polystyrene stored at 86% relative humidity. Films of methylcellulose do not show the effect. Numerically the effect seems to arise from the random motion of groups of several hundred ions as a unit. It is suggested and demonstrated that the moisture vapour diffusion constants for a series of polymers increase with the frequency of the loss factor maximum while the moisture vapour permeability increases with the d.c. conductivity. A.

537.228.1

6484. Piezo-electric properties of wood. V. A. BAZHENOV AND V. P. KONSTANTINOVA. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 2) 283–6 (1950) *In Russian.*

537.228.1 : 538.652 : 534.232

6485. The constants of magnetostrictive, electrostrictive and piezoelectric electro-acoustic convertors. U. JOHN. *Arch. elekt. Übertragung*, **4**, 139–45 (*April*, 1950) *In German.*

A theoretical treatment is given of the inter-

relationship of the various constants and a tabulated summary of the relevant formulae is included.

G. F. HODSMAN

537.228.1 : 548

6486. Polar and electrical properties of ice crystals. F. ROSSMANN. *Experientia*, **6** (*No.* 5) 182 (1950) *In German.*

A brief report on experiments on single ice crystals grown in a refrigerator. They had a piezo-electric effect 10 times greater than that of tourmaline and their polar properties were masked by twinning.

H. J. H. STARKS

537.228.1 : 548 : 621.39

6487. Quartz, its treatment and use in telecommunications technique. II. R. SUEUR, P. ANDRIEUX, J. NORBERT AND M. CORNEBISE. *Onde Elect.*, **30**, 140–8 (*March*, 1950) *In French.*

See Abstr. 6131 (1950). Describes how immersion of the crystals in a saturated solution of ammonium fluoride shows up the various faults and permits easy identification of the natural faces, also the optical instruments used in determining the various axis for cutting. The saws used for cutting are steel discs, diamond-impregnated on the periphery. After cutting, the laminae are ground between discs with an abrasive, the finest being 3 to 6 μ. They are finally adjusted for frequency by grinding with very fine diamond abrasive or treating with hydrofluoric acid. Ageing of the finished laminae is very much less if the latter method is used. A short description is given of the utilization of crystals in oscillators and filters.

B. B. AUSTIN (R)

537.24 : 541.182.3

6488. A dust electricity analyzer. W. B. KUNKEL AND J. W. HANSEN. *Rev. Sci. Instrum.*, **21**, 308–14 (*April*, 1950).

An apparatus is described by means of which the size and the charge of large numbers of microscopic particles can be simultaneously determined. The method is based on Hopper and Laby's work on the determination of the electronic charge, i.e. horizontal deflection of particles settling under gravity recorded photographically. The procedures involved are given in some detail, and the nature and limitations of the general results are discussed. Simplicity of operation and design are emphasized to render the instrument a workable tool in industrial research.

A.

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311 : 536.2 : 538.63 : 538.66

6489. Electrical and thermal conduction of single crystals of bismuth in transverse magnetic fields. E. GRÜNEISEN, K. RAUSCH AND K. WEISS. *Ann. Phys., Lpz.*, **7** (*No.* 1–2) 1–17 (1950) *In German.*

The conductivity was investigated experimentally. A previously discovered effect [*Ann. Phys., Lpz.*, **26**, 449 (1936)], a change of resistance during reversal of the field, was found to be dependent on the experimental conditions and not a fundamental characteristic of the crystals. A theoretical relation given by Kohler for the electrical resistance, ρ, $\Delta\rho/\rho_0 = F(H/\rho)$, is not obeyed. The thermal resistance w found to be much less dependent on H than i electrical resistance. Assuming that lattice co duction of heat is independent of H, the electro contribution may be calculated separately from t results, and for one of the crystals the observ Wiedemann–Franz–Lorentz constant agrees clos with Sommerfeld's value.

E. P. WOHLFAR

537.311.3 : 621.

6490. The linear theory of fluctuations arising fr diffusional mechanisms—an attempt at a theory contact noise. J. M. RICHARDSON. *Bell Syst. Tech.* **29**, 117–41 (*Jan.*, 1950).

Contact noise in carbon microphones, thin film crystals, etc., has a spectral density given by $S(\omega) = KsV_s^{a-2}\bar{R}^{b+2}\omega^{-1}$ where V = d.c. voltage acr contact, a, b, constants $\simeq 1{\cdot}85$ and $1{\cdot}25$ respe tively, $\bar{R}$ = mean resistance. The hypothesis th the resistance variations causing the noise are d to the diffusion of particles (electrons, atoms) or heat is here examined. The statistical problem solved by Fourier series and also by Smoluchowsk method and various forms of diffusing mechanis are discussed, it being shown that Schiff's hypothes of variation of concentration in a narrow regio between parallel planes yields $S(\omega) \propto \omega^{-\frac{1}{2}}$ instead $S(\omega) \propto \omega^{-1}$. The case of large, rough contac covered with diffusing layers does give $S(\omega) \propto \omega^{-}$ When $S(\omega) \propto \omega^{-1}$ the noise turns out to be ind pendent of D, the diffusion constant, so that ve slow rates of diffusion contribute as much noise fast ones. The tentative nature of the work emphasized.

A. H. W. BECK (

537.311.3 : 66

6491. Electrical properties of gold-chromium alloy J. O. LINDE. Letter in *Nature, Lond.*, **165**, 645- (*April* 22, 1950).

537.311.3

6492. Resistivity of pure metals at low temperature I. The alkali metals. D. K. C. MACDONALD AN K. MENDELSSOHN. *Proc. Roy. Soc., A*, **202**, 103–2 (*June* 22, 1950).

A technique is described for measuring resistanc in the temperature interval between $1{\cdot}5$ and 20° continuously. The resistivity of the alkali metals ha been determined in this temperature region, and th results have been discussed in comparison with theory The resistivity of Na has been found to agree closel with theory, while in the case of the other metals th hypothesis of quasi-free conduction electrons doe not seem to be fully justified. Certain observation suggest that small impurities may give rise to anomalie other than the phenomenon of "residual" resistance.

A

537.311.31 : 536.48 : 539.23

6493. Variations, as functions of applied potentia of the electrical resistance of very thin metallic deposits at low temperatures. N. MOSTOVETCH AND B. VODAR *C.R. Acad. Sci., Paris*, **230**, 934–6 (*March* 6, 1950 *In French.*

The electrical resistance R of vacuum-evaporate thin films of various metals, was measured fro 2°K up to room temperature, T_R. Normal films obe

n's law up to several tens of volts applied p.d., ere is no appreciable Joule heating. Some films w marked deviations below 20°K, and others ll deviations from T_R downwards. The tem- ature variation is given by $R_0 = AT^{-\frac{1}{2}} \exp(\theta/T)$ normal resistances; no simple variation is observed the films showing deviations from Ohm's law, this is taken to indicate a non-uniform film. results cannot be explained by a simple thermal ct. C. A. HOGARTH

537.311.33

4. On the anomalous electrical properties of Cu_2S. I. T. KUSHIDA. *J. Sci. Hiroshima Univ.*, 48–9 (*July*, 1949).

t has been found that there are three modifications semi-conducting Cu_2S which are stable above °C, from 110 to 470°C (β–Cu_2S) and below 110°C pectively. The β form exhibits ionic as well as ctronic (hole) conductivity and a number of malous characteristics are observed. When stant current pulses are passed through a speci- n, the corresponding voltage drop shows pro- nced hysteresis effects. The conditions under ich these effects are observed are discussed in ne detail. H. K. HENISCH

537.311.33

95. Theories of high values of alpha for collector ntacts on germanium. W. SHOCKLEY. Letter in *ys. Rev.*, **78**, 294–5 (*May* 1, 1950).

537.311.33

96. Comment on mobility anomalies in ger- nium. G. L. PEARSON, J. R. HAYNES AND W. OCKLEY. Letter in *Phys. Rev.*, **78**, 295–6 (*May* 1, 50).

Comparison of the mobilities obtained from periments on the drift of injected current carriers, e conductivity due to added Sb, and the Hall fect, suggest that the energy surfaces for holes and ctrons in Ge are not spherical. R. B. DINGLE

537.311.33 : 621.315.59

97. Observations of the rapid withdrawal of ored holes from germanium transistors and varistors. A. MEACHAM AND S. E. MICHAELS. Letter in *hys. Rev.*, **78**, 175–6 (*April* 15, 1950).

The application of square pulses to transistors is udied, and the bursts of collector current caused by e preceding emitter current are explained by the pid collection of holes produced by the forward mitter current and existing in the Ge at the time of plication of collector potential. With suitable ming circuits the same electrode may be used as oth emitter and collector. Varistors (Ge diodes) ay be divided into three classes so far as response to pplied voltage pulses is concerned, and these classes re not directly related to steady-state *V–I* charac- ristics. In some cases large bursts of power in the nits are associated with the application of a short- uration pulse. C. A. HOGARTH

537.311.33 : 621.315.59 : 621.314.63

498. Crystal diode and triode action in lead sulphide. I. A. GEBBIE, P. C. BANBURY AND C. A. HOGARTH. etter in *Proc. Phys. Soc., Lond., B*, **63**, 371 (*May*, 950).

537.312.5 : 535.215

6499. Contribution to the photoelectric conduction in PbS. L. GENZEL AND H. MÜSER. *Z. Phys.*, **127** (*No.* 3) 194–200 (1950) *In German.*

The secondary photo-electric effect in PbS cells, caused by irradiation with u.v. energy (2 500 to 10 000 Å) is counteracted by irradiation with white light up to 6 500 Å. Infrared has no such effect. Under i.r. irradiation the photocurrent is immediate and constant. No secondary effects. Light produces the same type of photocurrent which, with time, is reduced to a value that may fall below the dark current. U.v. irradiation results in a similar type of photocurrent which increases very slowly. After switching off the u.v., the resistance of the PbS remains constant, but falls off slowly after many hours. Light greatly accelerates this falling off effect. The lattice absorption begins at 3 200 Å. The distance of the energy level is 3·88 eV. It is assumed that the photoeffect is due to an O compound in the PbS layer, the former being formed during the tempering of the PbS. An exact prescription for making PbS layers is given. W. SUMMER

537.312.5 : 535.215

6500. Photovoltaic effect of *P–N* junctions in germanium. M. BECKER AND H. Y. FAN. Letter in *Phys. Rev.*, **78**, 301–2 (*May* 1, 1950).

537.312.62

6501. On the connection between superconductivity and mixed conductivity. H. WELKER. *Ann. Phys., Lpz.*, **5** (*No.* 1–2) 1–13 (1949) *In German.*

On the basis of theoretical considerations on the band-model and from experimental results it is shown that only conductors with overlapping electron bands can become superconductors. The magnitude of the translatory zero point energy of the conduction electrons and positive holes gives a measure of the value of the transition temperature. H. LONDON

537.312.62

6502. A non-linear phenomenological theory of superconductivity. M. v. LAUE. *Ann. Phys., Lpz.*, **5** (*No.* 3–5) 197–207 (1949) *In German.*

This new form of the phenomenological theory takes over from the older theories the separation of the conduction mechanism into an ohmic and super-conductive contribution. For the latter it takes over the London equations but replaces the so far linear connection between momentum and current density by a non-linear one, which is still kept in very general terms. All essential theorems of the older theory are maintained completely or, e.g., in the case of the Meissner effect, in their essential character, and therefore agreement with the experimental evidence is preserved. Essential deviations can be expected with alternating fields at high amplitudes. This new form is suitable for the notion of a maximum current density to form a part of it. H. LONDON

537.312.62

6503. On the theory of superconductivity. F. MÖGLICH AND R. ROMPE. *Ann. Phys., Lpz.*, **6**, 177–92 (1949) *In German.*

A discussion on the basis of the authors' theory of plasma oscillation [Abstr. 1557 (1948)]. The explanation of the magnetic threshold field, given in Abstr. below, is withdrawn in favour of the old thermo-

dynamic relation that transition occurs when the kinetic energy of the supercurrent equals the free energy difference between the normal and superconductive state. It is not shown, however, that current distributions other than those given by the London equations, which could give a lower kinetic energy, are impossible in the superconductive state. Instead a proof is given that the interaction between the transversal plasma oscillations and the lattice practically disappears. H. LONDON

537.312.62

6504. The magnetic threshold value in the theory of superconductivity. F. MÖGLICH AND R. ROMPE. *Ann. Phys., Lpz.*, **3**, 322–6 (1948) *In German.*

The London relation between current density and vector potential is a solution of the equation of motion of the plasma [Abstr. 1557 (1948)] only as long as the kinetic energy of the drift velocity of the electrons $\frac{1}{2}mv^2 \ll \partial E_0/\partial n_0$. Here E_0 is the zero point energy of the electron gas and n_0 the electron density. It is assumed that superconductivity breaks down when $\frac{1}{2}mv^2 \simeq 0{\cdot}01\ \partial E_0/\partial n_0$. If one assumes for E_0 the value resulting from the Sommerfeld theory magnetic threshold values of 10^4 to 10^5 are obtained. The fact that these values are 10 to 100 times larger than the observed values is ascribed to the fact that the Sommerfeld theory does not take account of the lattice field [see Abstr. above]. H. LONDON

537.312.62

6505. On the theory of incomplete superconductivity. H. KOPPE. *Ann. Phys., Lpz.*, **6**, 375–80 (1949) *In German.*

The behaviour of a material which contains small inclusions in the superconductive state in a normally conducting base is investigated. One obtains in this case an ohmic conductor with a conductivity highly dependent on the magnetic field. H. LONDON

537.312.62 : 538.12 : 535.34

6506. The penetration depth of magnetic fields in superconductors and absorption in metals. F. MÖGLICH AND R. ROMPE. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 6) 335–51 (1949) *In German.*

A connection is established between the penetration depth and an absorption edge in the short-wave part of the visible region. The absorption in question is of the type discovered by Wolter [*Z. Phys.*, **105** (*No.* 5-6) 269–308 (1937)] which occurs in thin metal films and is here ascribed to resonance of the plasma oscillations [Abstr. 1557 (1948)]. It does not occur in bulk metal because of the hindrance connected with the transfer of both momentum and energy from the electromagnetic waves to the plasma oscillations. For small thicknesses the conservation of momentum need not be fulfilled with high accuracy. The calculated thicknesses at which this absorption becomes apparent agrees with the measurements on Ag discussed by Wolter and the position of the edge found by R. Havemann on Hg colloids confirms the relation with the penetration depth. H. LONDON

537.312.62 : 538.3

6507. The energy-momentum tensor in the Laue–London electrodynamics of superconductors. G. U. SCHUBERT. *Ann. Phys., Lpz.*, **6**, 163–8 (1949) *In German.*

The conservation laws for energy and momentum of a superconductor at rest can be represented in relation between Lorentz-invariant quantities. expression for the force density is given which can derived from the energy momentum tensor.

H. LONDO

537.312.62 : 539.155

6508. Isotope effect in the superconductivity mercury. E. MAXWELL. Letter in *Phys. Rev.*, **78**, 4 (*May* 15, 1950).

537.312.62 : 539.155

6509. Superconductivity of isotopes of mercu C. A. REYNOLDS, B. SERIN, W. H. WRIGHT AN L. B. NESBITT. Letter in *Phys. Rev.*, **78**, 487 (*May* 1 1950).

537.

6510. Thermoelectric voltage in lead telluri R. WYRICK AND H. LEVINSTEIN. Letter in *Phys. Rev* **78**, 304–5 (*May* 1, 1950).

537.32 : 537.312.

6511. Thermoelectromotive force of superconducti *versus* normal junctions of the same metal. M. STEELE. Letter in *Phys. Rev.*, **78**, 308 (*May* 1, 195

537.323 : 537.311.

6512. Effect of mercury on the thermo-electr properties of selenium. H. K. HENISCH AND M FRANÇOIS. Letter in *Nature, Lond.*, **165**, 891 (*June* 3, 1950).

ELECTRIC DISCHARGES 537.52

537.52 : 537.12

6513. Electron diffusion in a spherical cavity A. D. MACDONALD AND S. C. BROWN. *Canad. Res., A*, **28**, 168–74 (*March*, 1950).

The diffusion equation for electrons in a non uniform field is solved and the breakdown conditio derived. The breakdown condition is expressed i such a manner that an effective characteristic diffusio length Λ_e is determined; the meaning of Λ_e expresse the equivalent characteristic diffusion length fo uniform electric fields. From the experimenta breakdown fields, in which the electric field is uni form, Λ_e is determined and used to predict theoretica breakdown curves for the non-uniform cases. Theor and experiment are compared, the agreement verifyin the correctness of the approach. A

537.52 : 537.533.7

6514. A determination of the energy distribution o electrons in the positive columns of gas discharges C. HAIGH AND T. SMITH. *Phil. Mag.*, **41**, 557–6 (*June*, 1950).

The electron energies in the positive column of low pressure hot cathode glow discharges have been examined by the magnetic spectrum method. From measurements of the energy distribution of electrons reaching a positive probe a method of finding the space potential is deduced. With this knowledge a comparison is made of the energy distribution o electrons, in the positive columns of air and A discharges, determined by the present method and the conventional probe method. Wide discrepancies are

rved. The magnetic spectrum indicates a distri-
on of the Druyvesteyn form whilst that deduced
n probes is Maxwellian. The changing form of
distribution reaching negative probes is proof of
failure at these pressures of the assumptions on
h Langmuir probe theory is based. Calculations
Boyd on positive ion sheath formation may give
e indication of the mechanisms producing the
nging distribution. A.

537.52 : 537.563

5. Diffusion theory of the positive column with rd to stepwise ionization. E. SPENKE. *Z. Phys.*, (*No.* 3) 221–42 (1950) *In German.*

he Schottky diffusion theory is considered with further introduction of carriers by stage-wise zation, since the original theory was not applicable ases where multiple ionization could be expected. mathematical implications for a double-staged zation process are worked out, and the differential ation and boundary conditions for various ributions of the carriers are derived; also the hematics of the cylindrical symmetrical discharge.

H. H. HODGSON

537.523.4

6. Mechanism of the electric spark. F. WELLYN JONES AND A. B. PARKER. *Nature, Lond.*, , 960–2 (*June* 17, 1950).

he growth of initial photo-electric currents $\simeq 10^{-14}$ A) with electrode separation d up to cm under uniform electric fields Z in the range Z/p from 39–45 V/cm mm Hg was examined at a ssure p of 200 mm Hg for voltages V up to 30 kV. e results show that if the currents i are measured values of d sufficiently close (within 20%) of sparking distance, then the growth is repre-ted by the Townsend equation $i/i_0 = \alpha d/\{1 - (\omega/\alpha)(\exp \alpha d - 1)\}$. This result indi-es the existence of a general Townsend secondary ct (ω/α) at those high values ($\leqslant 760$ cm mm Hg) the spark parameter pd for which it has been erally assumed that the Townsend secondary ct did not exist. The experiments also showed t at these values of pd the cathode influences the rk mechanism through the action of positive ions.

F. LLEWELLYN JONES

537.523.5

17. The temperature in the column of the Gerdien R.-W. LARENZ AND H. BARTELS. *Naturwissen-haften*, **37** (*No.* 7) 164 (1950) *In German.*

537.523.5 : 536.55

18. A new method of temperature measurement high temperature arc discharges. H. BARTELS. *Phys.*, **127** (*No.* 3) 243–73 (1950) *In German.*

Describes a new spectroscopic method of measuring mperatures in discharge plasmas, which has par-ular value in cases where other methods (line ensity ratios, etc.) may fail because of self absorp-n. Indeed, the presence of self absorption, leading a decrease in the intensity at the centre of a line is cessary for the application of the new method hich deduces temperatures from measurements of e intensity maxima on each side of the self-absorp-n trough at the line centre. Lines whose lower tes lie appreciably above the ground state are nsidered. J. D. CRAGGS

537.525

6519. A theoretical explanation of the Joshi-effect. S. N. GARG. Letter in *Curr. Sci.*, **19**, 115–16 (*April*, 1950).

537.525

6520. Production of an irreversible Joshi effect in the hysteresis-range below the threshold potential. B. R. MARATHE AND S. S. BOMMANNAVAR. Letter in *Nature, Lond.*, **165**, 890–1 (*June* 3, 1950).

537.525.5

6521. The energy transfer due to electron collisions in mercury vapour plasmas. T. WASSERRAB. *Z. Phys.*, **127** (*No.* 4) 324–33 (1950) *In German.*

Discusses the relation between the energy input to a plasma, from elastic and inelastic collisions (of the first kind) with electrons, and such parameters as the longitudinal voltage gradient. A detailed treatment for Hg vapour is given on the assumption of a Maxwellian distribution of electron energies.

J. D. CRAGGS

537.525.72

6522. Excitation of h.f. pulsed discharges in low pressure gases. J. ROIG AND A. BURET. *C.R. Acad. Sci., Paris*, **230**, 1394–6 (*April* 12, 1950) *In French.*

Describes the excitation of pulsed h.f. discharges in gases at pressures $\sim 10^{-2}$ mm Hg and with $\lambda \sim 10$ m. Arc lines are usually prominent, but spark lines can be excited with powers ~ 10 kW. The circuit technique, described in some detail, forms the major part of the paper. J. D. CRAGGS

537.527.5

6523. The radial temperature variations in wall-stabilised high pressure mercury arcs. O. KOCH, K. J. LESEMANN AND A. WALTHER. *Z. Phys.*, **127** (*No.* 1–2) 153–62 (1950) *In German.*

The Elenbaas-Heller equations, relating the radial structure of a wall-stabilized h.p. arc to the various physical parameters of the discharge, are discussed. Solutions of the equations were checked against experimentally determined values of radial temp. variations, with good agreement. In this work allowance for temp. variations of thermal conductivity was made. J. D. CRAGGS

537.527.5

6524. On the breadth of wall-stabilised arc discharges. G. SCHMITZ. *Z. Phys.*, **127** (*No.* 3) 209–14 (1950) *In German.*

Solutions of the Elenbaas–Heller equation relating to the radial structure of a h.p. arc were compared with quoted exptl. data, ignoring temp. variations of thermal conductivity. The agreement was satisfactory and it was concluded that the assumptions were justified for arc loadings > 30 watts/cm length.

J. D. CRAGGS

537.529

6525. Dielectric deterioration due to internal discharges. J. H. MASON. Letter to *Nature, Lond.*, **165**, 932 (*June* 10, 1950).

Polythene disks containing small cylindrical voids have been tested at 150 kc/s. Initially discharges cause slow erosion at the surfaces of the void, and a transparent resin which fluoresces in u.v. light is formed. The rate of deterioration increases rapidly

with excess voltage; at twice the discharge inception voltage several deep uncarbonized pits are formed near the periphery of the void after a few hours. When the pits attain a critical length, narrow carbonized channels are formed and in general, breakdown follows rapidly. Deterioration is greater when the void is adjacent to an electrode than with the void enclosed in polythene. Photographs illustrate the surface erosion and pit formation. Polytetrafluorethylene and acrylic resin are less resistant than polythene. J. H. MASON

X-RAYS 537.531

537.531 : 535.33

6526. On the effect of the width of the microphotometer slit on the recorded width of the lines of X-ray spectra. B. G. GOKHALE. *C.R. Acad. Sci., Paris,* **230,** 636–8 (*Feb.* 13, 1950) *In French.*

The effect is calculated theoretically and is found to agree well with experiment. J. THEWLIS

537.531 : 535.338.1

6527. Study of the *K* spectrum of selenium in the gaseous phase. J. MORLET. *Bull. Acad. Roy. Belge Cl. Sci.,* **35** (*No.* 12) 1059–64 (1949) *In French.*

Gives details of the *K* spectra from Se using a curved mica crystal spectrograph. Previous comparable work is by Groven on Zn and As in the gaseous state [see Abstr. 341 (1948)]. The results are tabulated, and sample spectra are shown as microphotometer plots. J. D. CRAGGS

537.531 : 535.34

6528. The absorption of X-rays in the case of interference. G. BORRMANN. *Z. Phys.,* **127** (*No.* 4) 297–323 (1950) *In German.*

Describes experiments, carried out with a commercial Cu-target X-ray tube and a calcite crystal, which show that the usual ideas about X-ray absorption are inadequate in the case of the passage of a divergent bundle of rays through a thick crystal. The absorption is negligible in any incident direction that satisfies the Laue conditions, and in the corresponding direction of reflection. Moreover the absorption coefficient decreases with increasing crystal thickness. The appropriate reflections and relevant portions of the incident beam may be recorded photographically in conditions (e.g. after passage through a crystal of thickness 2·7 mm) where one would not normally expect to obtain any effect in the exposure time employed. J. THEWLIS

537.531 : 535.4

6529. X-ray interference by one-dimensional lattices with liquid arrangement. R. HOSEMANN. *Z. Phys.,* **127** (*No.* 1–2) 16–40 (1950) *In German.*

A mathematical treatment of the problem of the diffraction of monochromatic X-rays by substances, such as high polymers, consisting of one dimensional lattices, taking account of the distortions which can occur. Attention is paid to the distribution of intensity around the central spot as well as to the outer reflections. J. THEWLIS

537.531 : 621.386.7

6530. A method for increasing the safe power in of X-ray tubes. A. I. BERMAN. *Rev. Sci. Instru* **21,** 275–9 (*April,* 1950).

A method for cooling X-ray tubes was devisi based on the principle of relative motion between target and focal spot. The electron beam is deflec by a rotating magnetic field so that the focal sp moves in a circle upon the target face. Simultaneous the tube itself is gyrated (without rotation about axis) so that any point on the target describes equal circle. The two rotations are equal in f quency, but phased 180 deg. from each other. Th the focal spot remains stationary in laboratory spa The advantages are (1) it is adaptable to most X-r tubes with target face perpendicular to the tube a and target diameter twice that of the longest fo spot dimension, without any modification of t design; (2) it combines the benefits of a rotati target, water-cooled target, and line focus witho the need for rotating joints or vacuum connectio Tubes, operating continuously for hours at a ti at a gyrating frequency of 6 r.p.s. have been coo successfully by this method without observa shifting of the focal spot in laboratory space.

CATHODE RAYS . POSITIVE RAYS 537.533/.5

537.533 : 621.384

6531. The design of electron synchrotrons. F. GOWARD, J. D. LAWSON, J. J. WILKINS AND CARRUTHERS. *Instn Elect. Engrs, Paper No.* 9 (1950) 14 *pp.*

The principles of design of the 30 MeV synchrotr are described in relation to general design princip for machines of up to 400 MeV. The mechanism operation of electron synchrotrons is described, a formulae are derived for design parameters. T design of synchrotron magnets, accelerating chambe and electronic equipment is then considered, and t radiation characteristics of the machines are describe The paper is illustrated by experiments on the 30 M A.E.R.E. synchrotron, and by design data on t 375 MeV Glasgow synchrotron.

537.533 : 621.384

6532. The design and operation of a 30-Me synchrotron. D. W. FRY, J. DAIN, H. H. H. WATSO AND H. E. PAYNE. *Instn Elect. Engrs, Paper No.* 9 (1950) 15 *pp.*

Outlines the constructional and electrical featur of a 30 MeV synchrotron. Two types of magnet a described, and their performances are compare Details are given of the accelerating chamber, with evacuating system, and of the electronic equipme required to control and monitor the machine operation. The general behaviour is discussed wi the help of experimental results. These include t effects of misalignment and disturbance in t magnetic field, gas scattering of the electrons, vari tions in the injection process, and change in t parameters of the r.f. accelerating field.

537.533.7

Energy loss of fast electrons in Be, C, H_2O, nd Pb. W. PAUL AND H. REICH. *Z. Phys.*, **127** 4) 429–42 (1950) *In German.*

ie energy distribution of electrons which have accelerated in a betatron to energies of 2·8 and MeV is determined by a beta-spectrograph before after passage through Be, C, H_2O, Fe and Pb. form of the distribution curve changes markedly atomic number and the primary energy of the rons. The mean energy-losses, determined from curves, are discussed in the light of the Bethe– h and Halpern–Hall theories. J. THEWLIS

537.533.7

4. On the theory of electron acceleration in an rnating magnetic field. III. Supplements. J. RT. *Optik*, **6**, 133–44 (*March*, 1950) *In German.*

ee Abstr. 5031–2 (1950) for previous parts. assumption of a magnetic field everywhere pro- tional to t and hence of a Hertzian vector to t^2 is wn to be not strictly tenable with Maxwell's ations. The equations for the magnetic lines of e for a field described by its Hertzian vector is en, and a method of approximate solution is ked out. The shape of the pole pieces to give h a field is worked out approximately on the umption that they will be orthogonal trajectories he lines of force. A particular example is worked nerically. W. I. B. SMITH

537.533.72

35. Theory of a new β-spectrograph with focal lation. P. GRIVET. *C.R. Acad. Sci., Paris*, **230**, 18–50 (*March* 13, 1950) *In French.*

Shows that the electron optical properties of the pectrograph described by Siegbahn and Slätis n be explained by the author's previously published ults. J. THEWLIS

537.533.72

36. Extension of Lagrange–Helmholtz formula third orders. P. GRIVET. *C.R. Acad. Sci., Paris*, 0, 1152–4 (*March* 20, 1950) *In French.*

The correct form of the Lagrange-Helmholtz rmula to take account of 3rd-order terms, wrongly ven in a recent paper by W. Glaser, is derived, ing 2 methods based on Seidel's ikonal and on the eory of trajectories. H. J. H. STARKS

537.533.72

37. Remarks on the influence of space-charge on e phase-focusing of electron beams and the work of Labus with the same title. F. BORGNIS. *Z. Naturrsch*, **5a**, 175 (*March*, 1950) *In German.*

Discusses the effect of assuming that there is no ngitudinal electric field in the drift space when a ense electron beam is injected, an assumption which as criticized by Labus. [Abstr. 2546 (1949)].

A. H. W. BECK

537.533.72

538. Remarks on the influence of space-charge on ie phase-focusing of electron beams. J. LABUS. *Naturforsch*, **5a**, 176 (*March*, 1950) *In German.*

Reply to discussion in preceding Abstr.

537.533.72 : 535.822

Electrons *vs.* photons: a comparison of microscopes. *ee Abstr.* 6427

537.533.72 : 539.165.08

6539. Principle of a double-lens spectrometer for β and γ rays. W. BOTHE. *Naturwissenschaften*, **37** (*No.* 2) 41 (1950) *In German.*

Thin lenses have necessarily a strong spherical aberration. It is shown that the use of 2 thin lenses can greatly increase the resolving power without decreasing the intensity. An instrument is under construction with a resolving power ten times that of a single lens and equal intensity. The arrangement is similar to that of Slätis and Siegbahn [Abstr. 7068 (1949)] who used a thick lens. W. I. B. SMITH

537.533.72 : 539.165.08

6540. Theory of the β-ray spectrograph with short coils. P. GRIVET. *C.R. Acad. Sci., Paris*, **230**, 936–7 (*March* 6, 1950) *In French.*

Considers the β-ray spectrograph described in recent notes [Abstr. 4126–7 (1950)] with short focusing fields. Expressions for the axial field are given and the resolving power calculated. A comparison is made between the model with uniform field, the model with short fields and Siegbahn's type. The latter has the best resolving power, the short coil model the worst. A. H. W. BECK

537.533.72 : 539.165.08

6541. On the theory of β-ray spectrometers which use a uniform axial magnetic field. P. HUBERT. *C.R. Acad. Sci., Paris*, **230**, 1464–5 (*April* 17, 1950) *In French.*

Referring to 2 earlier papers [Abstr. 3255, 4022 (1949)] it is claimed that either the number of diaphragms may be reduced for the same aperture and resolution, or the resolution increased for the same aperture and number of diaphragms. B. ROSE

537.533.72 : 621.385.833

6542. The calculation of magnetic lens fields by relaxation methods. M. B. HESSE. *Proc. Phys. Soc., Lond., B*, **63**, 386–401 (*June*, 1950).

The field and lens constants are calculated for 2 typical magnetic lenses as used in electron microscopes, using the relaxation method developed by Southwell for the solution of potential problems. The results are compared with those based on simple analytic approximations to the field distribution in the work of Glaser and Ramberg, and are shown to agree closely as regards those characteristics on which the discussion of the performance of the lens is based. A.

537.533.72 : 621.385.833 : 621.384.6

6543. Electron optics at h.f. and relativistic velocities. D. GABOR. *Rev. Opt. (Théor. Instrum.)* **29**, 209–31 (*April*, 1950) *In French.*

Is limited to electrons in axial symmetric fields. The field is described by two vector potentials, the usual magnetic vector potential and Born's "anti-potential." The field equations are developed and the difference between d.c. and h.f. conditions explained. Relativistic dynamics is then discussed, leading to an expression for the focal length of a long magnetic field. This tends to $L = 2{\cdot}1 \times 10^4\, MV^{\frac{1}{2}} H^{-1}$ (MV = energy in MeV units, cm, gauss^{-1}) for small energies and $L = 2{\cdot}1 \times 10^4\, MVH^{-1}$ for high. Problems in varying fields are then discussed and applications to the behaviour of lenses in

particle accelerators made. A dissertation on the stability of linear accelerators concludes the work.

A. H. W. BECK (R)

537.533.73

6544. Anomalous refraction effect in electron diffraction. S. MIYAKE AND G. HONJO. Letter in *Nature, Lond.*, **165,** 644–5 (*April* 22, 1950).

Values of the refractive index for electrons obtained from measurements of the splitting of diffraction spots from samples of MgO and CdO vary markedly with the indices of the reflections and are sometimes extraordinarily high. They are explained in terms of Bethe's dynamical theory, assuming for each reflecting plane the presence in the crystal of 3 strong rays, 1 primary and 2 diffracted. J. THEWLIS

537.533.73

6545. Line breadth in electron diffraction. A. L. G. REES AND J. A. SPINK. Letter in *Nature, Lond.*, **165,** 645 (*April* 22, 1950).

The breadth of electron diffraction rings which are obtained with a high-resolution electron diffraction camera are discussed, and it is concluded that the observations can be accounted for completely by refraction, crystallite size and shape, and spread of lattice parameters. J. THEWLIS

537.533.74

6546. The scattering of electrons by hydrogen atoms. H. S. W. MASSEY AND B. L. MOISEIWITSCH. Letter in *Phys. Rev.*, **78,** 180–1 (*April* 15, 1950).

The results of applying a variational method to the scattering of electrons by H atoms, exchange effects being taken into account, are briefly described and compared with those of other investigators. The method is that of Hulthèn [Abstr. 492 (1945)], but the trial wave functions are of the form used by Huang [Abstr. 317 (1950)] except for the exchange terms. M. R. HOPKINS

537.533.74

6547. Saturation backscattering of positive electrons. H. H. SELIGER. Letter in *Phys. Rev.*, **78,** 491–2 (*May* 15, 1950).

537.533.8 : 548.7

6548. "Bremsstrahlung" in crystals. B. FERRETTI. *Nuovo Cim.*, **7,** 118–34 (*March*, 1950) *In Italian.*

It is proved that the radiation of a high energy electron moving in a periodic structure depends very markedly on the direction of propagation, and that this interference effect becomes more and more important when the energy of the particle increases. The reason for this curious behaviour is that the momentum Δp transferred to a lattice nucleus in a collision remains always $< m_0c$, even at the highest energies. Thus $h/\Delta p$ remains of the same order as the lattice distance for any value of p. At infinite energies the crystal becomes transparent along every direction except along those whose direction cosines α_i satisfy the relation $n_1\alpha_1 + n_2\alpha_2 + n_3\alpha_3 = 0$ (the n_i being whole numbers). The thermal fluctuations of the lattice produce a background, but do not alter essentially the features of the phenomenon. This process makes possible in principle the production of high energy gamma rays with an energy spectrum very different from that obtained in the usual Bremsstrahlung processes. L. PINCHERLE

537

6549. On the possibility of accelerating cha particles in a straight line without energy limit. HOYAUX. *Bull. Acad. Roy. Belge Cl. Sci.*, **36** (*No* 148–53 (1950) *In French.*

The limitations of various forms of linear accelera are discussed. Attention is mainly directed to problem of simultaneously maintaining phase-stabi and radial focusing. The possible advantages of accelerating e.m. wave composed of a number T.M. and T.E. modes are examined. It is shown t if the energy obtainable by heavy particles is to unlimited, a radial electrostatic field must be set

J. H. FREM

537.534 : 537.

6550. On the electron dynamics in a one stage lin accelerator with periodically varying field. H. KNUDSON. *Trans Danish Acad. Tech. Sci.* (*No.* 54 *pp.* (1949).

The motion of electrons starting in different pha in a uniform high frequency electric field is discuss An example is worked out numerically. Expli expressions for the electron position are obtained very large and very small fields. The shape of current pulse and uniformity of the energy distri tion are considered. W. I. B. SM

537.534 : 621.38

6551. A new method for particle injection in accelerators. W. B. JONES, H. R. KRATZ, J. LAWSON, G. L. RAGAN AND H. G. VOORHIES. *Ph Rev.*, **78,** 60–2 (*April* 1, 1950).

A beam was obtained in the betatron phase of small aperture synchrotron, when the normal metho had failed, by rapidly damping the Z-oscillations f a large number of circulations, and by removing th damping agent before it caused "undamping." T gun was displaced from the orbit in the Z-direction and damping was provided by passing a curre through a coil, to produce an azimuthal change in th field index n, $\pi/2$ beyond the gun. Later, during th injection pulse, the current was switched off; th time was critical to $\sim 1\,\mu$sec for a beam to b obtained, and azimuthal variations of n with r current in the coil had to be small to avoid undampin The best beam was obtained with $n = 0{\cdot}25$, and wa sensitive to a change in n of $0{\cdot}01$. Gun position wa not critical, and a beam was obtained through a aperture $\pm \frac{3}{8}$ in. in Z and $\pm \frac{1}{2}$ in. in r, for orb radius 24 in. The principle of the method is discusse in some detail; it may be applied to radial injectio

T. G. PICKAVANCE (

537.534 : 621.384.6

6552. High energy accelerators at the University California Radiation Laboratory. G. F. CHEW AN B. J. MOYER. *Amer. J. Phys.*, **18,** 125–36 (*Marc* 1950).

The principles of operation, phase and directio focusing properties and operational characteristics 3 Berkeley accelerators are discussed. The line accelerator is a resonant cavity 40 ft long, excited a longitudinal electric mode with 2·5 MeV peak pow at ~ 200 Mc/s. Protons, injected by a 4·5 Me Van de Graaff generator, are accelerated to 32 Me in pulses of 600 μsec, 30 per sec. The mean curre is $0{\cdot}25\,\mu$A and the energy spread < 100 keV; 85

he beam passes through a $\frac{1}{8}$ in dia. hole. The in synchro-cyclotron produces 120 pulses/sec 190 MeV deuterons, 380 MeV α-particles or MeV protons, with variable energy for internal ns and fixed (maximum) energy for external ns. The synchrotron accelerates electrons, with orbit radius, to 335 MeV; there are 6×10^8 rons/pulse, 6 pulses/sec, giving 2 300 R/hr at 1 m. 3 machines have been consistently available for ration about 90% of the time. There is an introory discussion of the fields of research covered he machines. T. G. PICKAVANCE

537.534.74

3. On scattering induced curvature for fast ged particles. W. T. SCOTT AND H. S. SNYDER. *s. Rev.*, **78,** 223–30 (*May* 1, 1950).

he exact solution recently obtained for the smallle plural and multiple scattering of fast charged icles is used to derive several theorems of interest cerning scattering-produced curvatures, and calations are reported of the probability distribution such curvatures. Formulae are provided for aining the probability of occurrence of curvatures ater than any given amount, for any scattering erial and energy, as long as the scattering is not large. The types of curvature measurement dealt n are: (*a*) three-point observation, (*b*) mean vature using the tangents to the track at each end, (*c*) difference between the two curvatures obtained *b*). Asymptotic formulae allow the calculations e extended for unusually rare events. A.

537.534.74

4. Inelastic scattering of protons by aluminum carbon. C. LEVINTHAL, E. A. MARTINELLI AND SILVERMAN. *Phys. Rev.*, **78,** 199–202 (*May* 1, 1950).

The energy distributions of inelastically scattered tons from C and Al were found by range measurents with the detection taking place in photographic tes. The C distribution shows 2 levels in C^{12}, at 4·8 and one at 10·1 MeV. There is also a 3rd k assigned on account of its energy and intensity deuterons in which the C^{11} from the reaction $(p,d)C^{11}$ is left in its ground state. The Al results w a continuum. An attempt is made to fit the tribution using a nuclear level density of from $E) = C\exp(AE^{\frac{1}{2}})$ as suggested by Weisskopf. e results fit fairly well at excitations above 15 MeV d not at all at excitations below that. A.

537.534.74 : 537.133

5. Deuteron-proton scattering at 10 MeV. K. B. ATHER, H. J. KARR AND R. O. BONDELID. Letter in *ys. Rev.*, **78,** 292–3 (*May* 1, 1950).

537.534.75 : 778.3

6. On the stopping power of nuclear emulsions charged particles of low energy. P. CÜER, J.-P. NGCHAMP, J. COMBES AND S. GORODETZKY, *R. Acad. Sci., Paris*, **230,** 832–4 (*Feb.* 27, 1950) *In nch.*

The stopping power of Li-loaded Ilford D_1 emulns towards very slow tritons is determined by serving the reaction $Li^6 + n = He^4 + H^3$. For se slow particles with an equivalent path length protons in air of 2 cm, the photographic method stated to be less accurate than the cloud chamber. W. F. BERG

537.534.75 : 778.3

6557. Experimental determination of the penetration-energy relations and of the stopping power of nuclear emulsions for charged particles of low energy. H. FARAGGI. *C.R. Acad. Sci., Paris*, **230,** 1398–9 (*April* 12, 1950) *In French.*

Previous work on protons of < 1 MeV and α-particles of $< 2{\cdot}1$ MeV has been supplemented by experiments on α-particles from Po in the range 2–4 MeV. The results are said to be valid within 5% for all nuclear emulsions. The stopping power is generally greater than that calculated from atomic constants. S. T. HENDERSON

DISCHARGE TUBES . COUNTERS 537.54

537.542

6558. On a phenomenon observed with Geiger–Müller counters in ultraviolet measurement. I. NONAKA. *J. Phys. Soc. Japan*, **3,** 322–7 (*Sept.–Dec.*, 1948).

In expts. with self-quenched Geiger counters on the measurement of near u.v. radiation, it was found that, particularly with Al, Mg or Zn cathodes, the counter sensitivity increased appreciably during irradiation. Details of the effect are given, with a tentative explanation. J. D. CRAGGS

537.542

6559. The determination of the resolving time of Geiger counters. G. GUÉBEN. *Bull. Soc. Roy. Sci. Liège*, **18,** 60–71 (*Feb.*, 1949) *In French.*

Discusses the various methods available for the determination of the resolving times of counters and gives appropriate references. Then a more detailed treatment of the method of compounded sources is given with exptl. details and results. This involves counting with source *A*, then with source *B* and finally with $(A + B)$ together. Another method (that of measuring the activity, with the test counter, and apparent rate of decay of a known radioactive element, decaying at a known rate) is briefly described and a set of results is given. J. D. CRAGGS

537.542

6560. The electric field in a Geiger counter. A. R. LAUFER. *Rev. Sci. Instrum.*, **21,** 252–4 (*March*, 1950).

537.542

6561. Electron component in Geiger discharge. G. G. KELLEY, W. H. JORDAN AND P. R. BELL. *Rev. Sci. Instrum.*, **21,** 330–2 (*April*, 1950).

Observation of the wave form of current during a Geiger discharge indicates the presence of a component due to electron collection amounting to as much as 50% of the total energy involved in the discharge. It appears, therefore, that the initial ion sheath can have a mean radius of the order of 10 to 15 times the radius of the centre wire. Apparatus is described, wave forms are shown and the method used to evaluate electron component and mean radius of ion sheath is indicated. Results for two tubes with different quenching vapours are tabulated. A.

537.542

6562. A review of Geiger–Müller and special counters. *Atomics*, **1**, 129–37, 153 (*May*, 1950.)

537.542 : 537.533.7

6563. An electron-beam decimal-counter tube. D. L. HOLLOWAY. Letter in *Nature, Lond.*, **165**, 856–7 (*May* 27, 1950).

537.542 : 538.63

6564. The effect of a magnetic field on the performance of Geiger–Müller counters. P. BASSI, I. FILOSOFO AND L. PRINZI. *Nuovo Cim.*, **7**, 83–93 (1950) *In Italian.*

An 8 000 gauss field parallel to the axis of the counter causes a large increase in the number of pulses delayed by about one μ sec, and decreases the effective length of the counter. A perpendicular field has no effect. These results are discussed in the light of the model generally adopted for the description of the discharges. L. PINCHERLE

537.542

6565. An improvement effect of the plateau in xylene- and argon-filled Geiger counters. B. TANYEL. Letter in *Phys. Rev.*, **77**, 843–4 (*March* 15, 1950).

537.542

6566. On the construction of metal G.M. counters. OM PARKASH. Letter in *Curr. Sci.*, **19**, 119–20 (*April*, 1950).

537.542

6567. A thin-windowed miniature Geiger–Müller counter. E. R. RAE. Note in *J. Sci. Instrum.*, **27**, 143 (*May*, 1950).

537.542 : 539.166.08

6568. Construction and performance of a multiple gamma-ray counter of high efficiency. T. GRÁF. *Rev. Sci. Instrum.*, **21**, 285–93 (*April*, 1950).

A multiple γ-ray counter is described, composed of 24 counter tubes connected in parallel. The tubes have Bi-plated brass screen cathodes and are placed inside the same envelope. Relative and absolute values for the efficiency of the counter were determined experimentally in the range 0·28 to 2·62 MeV. Compared to a single brass counter of similar dimensions, the multiple counter shows for γ-rays of, say, 0·7 MeV energy a tenfold increase in efficiency. Its starting voltage is 5–600 V lower. The "effective resolving time" of the multiple counter appears to be 3 to 4 μsec. The counting rate curve seems to follow the inverse-square law down to the shortest counter-source distances. The solid angle subtended by the multiple counter for sources, placed in its middle, is nearly 4π. A.

537.542 : 537.56

6569. On the fluctuations of the ionization effect. M. I. PODGORETSKIĬ. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 5) 823–6 (1949) *In Russian.*

Theoretical. Formulae are developed for the mean values of ionization, and of energy loss in proportional counters, and for the dispersion of these quantities. E. P. GEORGE

537.542 : 535.37

6570. On the relations between crystal counters and crystal phosphors. R. FRERICHS. *J. Opt. Soc. Amer.*, **40**, 219–22 (*April*, 1950).

It is shown that all crystals which yield pulses under irradiation with nuclear particles or gamma-r belong to the class of crystal phosphors. They sh luminescence by irradiation in the absorption ba a power law of decay and primary and second photo-currents. This statement is proven for C ZnS, AgCl, AgBr, TlCl, diamond of the Type 2 a solid argon.

537.

6571. A high pressure fitting for scintillation cou ing. K. D. TIMMERHAUS, E. B. GILLER, L. H. TU R. B. DUFFIELD AND H. G. DRICKAMER. Letter *Rev. Sci. Instrum.*, **21**, 261–2 (*March*, 1950).

537.

6572. Terphenyl and dibenzyl scintillation counte R. HOFSTADTER, S. H. LIEBSON AND J. O. ELL Letter in *Phys. Rev.*, **78**, 81 (*April* 1, 1950).

537.

6573. Performance of pulsed photo-multiplier scin lation counters. R. F. POST AND N. S. SHIREN. Le in *Phys. Rev.*, **78**, 81 (*April* 1, 1950).

537.

6574. Causes of abnormal efficiencies in scintillat counters. W. G. CROSS. Letter in *Phys. Rev.*, 185–6 (*April* 15, 1950).

Abnormally high efficiencies in scintillation coun systems are attributed to overloading of amplifi and to the multiple counting of crystals with relativ long decay of luminescence. G. F. J. GARL

537.

6575. Large-area scintillation counters. R. B CHELOR, J. W. SMITH AND L. BLACKMORE. Letter *Nature, Lond.*, **165**, 688 (*April* 29, 1950).

Large crystals of naphthalene (8 in dia.$\times\frac{1}{2}$ thickness) containing 1% anthracene have been ma for cosmic-ray research. Light collection from t crystals by the photo-multiplier tube is more effici when an integrating sphere or hemisphere is used th when a mirror is employed. G. F. J. GARL

537.5

6576. The temperature dependence of orga scintillation counters. S. H. LIEBSON AND J. KELLER, JR. Letter in *Phys. Rev.*, **78**, 305 (*May* 1950).

537.5

6577. Liquid scintillation counters. G. T. RE NOLDS, F. B. HARRISON AND G. SALVINI. Letter *Phys. Rev.*, **78**, 488 (*May* 15, 1950).

537.542 : 538.

6578. The effect of magnetic fields on the respon of gamma-scintillation counters. J. D. GRAV Letter in *Phys. Rev.*, **78**, 309–10 (*May* 1, 1950).

537.542 : 539.16.

6579. Measurement of the energy of alpha-, beta and gamma-rays by means of a scintillation count S. A. E. JOHANSSON. *Ark. Fys.*, **2**, *Paper* 18, 171– (1950).

A NaI–Tl crystal with 1P21 photomultiplier w used to explore the use of scintillation counters f energy measurements. For α particles (5 Me pulse spreads are $\pm$ 5% with an energy resolution $\sim$ 1%. By using the photoelectric effect in NaI– γ-ray energies can be measured with accuracy $\sim$ 1%. For β-rays Fermi plots yield an accura of 3% in energy determination. G. F. J. GARLI

537.542: 539.166

. The scintillation counter as a low resolution na-ray spectrometer. R. W. PRINGLE, K. I. LSTON AND H. W. TAYLOR. *Rev. Sci. Instrum.*, :16–18 (*March*, 1950).

scintillation γ-ray spectrometer has been de- ped, which is of particular use for the study of pes of low specific activity and in which the gies of the γ-rays are identified from the pulse ht distributions of the recoil electrons produced n activated NaI crystal. The Compton distri- ons are easily recognized, and a study of the diation of Co^{60} and I^{131} shows a proportionality xist between the total light output per scintillation the energy of the corresponding secondary β-ray icle. The noise level of the RCA 5819 photo- tiplier, as used in this test, corresponded to an gy on the pulse height scale of less than 20 keV. rief description is given of a new type of differential se height analyzer which has been developed for k of this type. A.

537.542 : 539.166.08

1. Calcium and cadmium tungstate as scintillation nter crystals for gamma-ray detection. R. H. LETTE. *Rev. Sci. Instrum.*, **21**, 294–301 (*April*, 0).

he high density, transparency, and chemical rtness of Ca and Cd tungstates, together with ir reasonable luminescent efficiencies when stimu- d with high energy radiation, strongly suggest ir use as phosphors in scintillation counters for ay detection. Some of the properties of these stals are reported and compared with anthracene. is shown that with proper design, the total anode rent produced by a given source is several times ater with the tungstates than with anthracene, hough the latter has a more favourable pulse size tribution. Cd tungstate has a zero temperature efficient of luminescence up to 40°c and shows no erglow after exposure to intense radiation. A.

537.542 : 539.166.08

Gamma-ray radiation monitor. *See Abstr.* 6726

537.542 : 621.318.572

82. A counting rate meter of high accuracy. H. COOKE-YARBOROUGH AND E. W. PULSFORD. *stn Elect. Engrs, Paper* 1015 (1950) 5 *pp.*

The paper describes a counting-rate meter with hich high accuracy and good linearity are obtained virtue of the circuit design, which makes the ading very nearly independent of valve charac- ristics. The causes of errors are analysed, and it is ncluded that no individual source is likely to ntribute an error of more than 1%. Tests indicate at an overall stability better than ± 1% is obtained practice. A.

537.542 : 621.318.572

583. A direct-reading apparatus for measuring ead time and recovery time of Geiger counters. . W. EPPRECHT. *Helv. Phys. Acta*, **23** (*No.* 3) 91–8 (1950).

The basic circuit uses an R-C-discharge, controlled y a scale of 2, as the means for time measuring. The hortest interval of successive pulses is selected and indicated. Some results obtained with the set are shown. A.

537.542 : 621.318.572

6584. Decade pulse counter for Geiger-Müller tubes. B. ÅSTRÖM. *Rev. Sci. Instrum.*, **21**, 323–6 (*April*, 1950).

A pulse counter of decade type, which does not require any components with narrow tolerances, has been designed. A direct reading system for the total count has been used, which eliminates all calculations. Several instruments of the type described here have been put to daily use for more than half a year without any failure. A.

537.542 : 621.396.615.17

6585. Pulse type regulated high voltage supply for G–M tubes. R. J. WATTS. *Rev. Sci. Instrum.*, **21**, 342–3 (*April*, 1950).

A 1 000-V variable supply is described, utilizing a 6BG6 tube to interrupt the current through a standard inductance. Rectification is by means of a CK1013 cold-cathode rectifier which eliminates a well-insulated filament transformer. The output is shunt-regulated by means of a 2C53 tube. An advantage of these supplies is the small size $5 \times 5 \times 6$ in and the economy in cost. Standard parts are used throughout. Ripple at 1 000 V is 80 mV. Regulation curves are given. A.

IONIZATION . THERMIONICS 537.56./.58

537.56 : 537.531 : 539.165

6586. Investigation of soft radiations. VII. Energy expenditure per ion-pair for slow electrons in various gases. S. C. CURRAN, A. L. COCKROFT AND G. M. INSCH. *Phil. Mag.*, **41**, 517–24 (*June*, 1950).

The proportional counter is applied to the problem of determining the energy expenditure per ion-pair formed in A, CH_4, C_2H_4, air, N, O and CO_2. Two different methods are applied. In the first the nearly homogeneous X-rays of Cu 64 are employed and the measurement of the number of disintegrations per minute occurring in a known fraction of the source is compared with the ion current through the same tube due to the whole source. Tritium gas is used likewise, in known relative amounts, to give rise to ion-currents and counting rates of easily measurable magnitudes. Hence the energy expenditure is obtained for the photo-electrons produced by $K\alpha$ X-rays and for the slow β-rays of tritium (average energy = 5·7 keV). The advantages obtained by using slow β-rays in counters are stressed. A.

537.561

6587. Measurement of appearance potentials of ions produced by electron impact, using a mass spectrometer. J. W. WARREN. Letter in *Nature, Lond.*, **165**, 810–11 (*May* 20, 1950).

537.568

6588. Dissociative recombination. D. R. BATES. Letter in *Phys. Rev.*, **78**, 492–3 (*May* 15, 1950).

The possibility of dissociative recombination involving molecular ions as an explanation for the high observed recombination rates, is briefly con-

sidered. It is concluded that such a recombination process may well be extremely rapid.

W. J. G. BEYNON

537.58

6589. Thermionic emission from the BaO–CaO system. L. E. GREY. Letter in *Nature, Lond.*, **165**, 773–4 (*May* 13, 1950).

The pulsed emission from mixtures of BaO and CaO was measured varying the CaO percentage. The pulses were of 2 μsec duration, 50 c/s repetition rate. The max. emission was 3·8 A/cm² at 1 000°K for 50–65% BaO. The BaO — SrO system was remeasured at the same time. The max. was 4·5 A/cm² at 30–40% BaO. [This is contrary to the original results of Benjamin and Rooksby, *Phil. Mag.*, **15**, 810 (1933) who for C.W. emission found the optimum Ba content to be about 50%.]

A. H. W. BECK

537.58

6590. Work functions of the elements. H. B. MICHAELSON. *J. Appl. Phys.*, **21**, 536–40 (*June*, 1950).

Like the chemical properties of the elements, the work function ϕ is a periodic function of atomic number, as shown clearly by a new compilation of published data for 57 elements. The progressive rise and fall of work function values throughout the table of the elements appears to be sufficiently regular to permit approximations to be made of values for the metallic and semimetallic elements on which no data has yet been published. Since the first ionization potential E_i and electrode potential E^0 exhibit a similar periodic function of atomic number, a striking resemblance exists among the respective plots of ϕ, E_i and E^0. A.

537.581 : 536.52

6591. Use of brightness temperatures in Richardson plots. H. F. IVEY. Letter in *J. Appl. Phys.*, **21**, 616–17 (*June*, 1950).

537.582 : 537.533.8 : 621.385.3

6592. On the grid emission. T. ARIZUMI AND S. NARITA. *J. Phys. Soc. Japan*, **4**, 300–5 (*July–Dec.*, 1949).

Various materials were exposed to activated oxide cathodes and their thermionic emission measured as a function of time of exposure, cathode temperature and cathode activity. The activation curves were unlike those for Th on W and it is thought that the evaporated material is BaO which forms minute crystals on the base material. For long evaporation times the work function of the contaminated material becomes equal to that of an oxide cathode and there is a direct correlation with the activity of the evaporating cathode. The effect of grid temperature was also studied and when the contamination was thick, the effect of increased temperature below the evap. point, was to activate the grid. The grid emission from W increased more rapidly than that from Ni. It is concluded that excess Ba evaporates more readily from small crystals than from large.

A. H. W. BECK

537.582 : 537.533.8 : 621.385.3

6593. On the mechanisms of the grid emission. K. NOGA AND Y. OKADA. *J. Phys. Soc. Japan*, **4**, 360–1 (*July–Dec.*, 1949).

It is found that at first the grid emission increases fast with time of evaporation then much more slow The rapid increase is due to the formation of monolayer and the subsequent behaviour approx mates to that of an oxide cathode. Heat treatme of the grid produces a final stable state which thought to correspond to a sintered layer of Ba crystals. The influence of the base metal (I_g Au $\simeq 10^{-5} \times I_g$ for W) is due to the different rates diffusion of Ba into the base. This is verified evaporating on to a base wire to 900°K. The cur for W goes through a max., Ni has no max. and t curve for Au is roughly 4 orders of magnitude small

A. H. W. BE

COSMIC RAYS 537.591

537.5

6594. Nuclear physics and cosmic rays. I. Cosm rays. W. BOTHE AND S. FLÜGGE. *FIAT Rev. Germ Sci.* (1939–46) 21–106 (1948) *In German.*

(*a*) Theoretical studies of mesons, nucleons an nuclear disruptions in cosmic rays (E. Bagge Summarizes work on meson production (Heisenber on the attenuation of the meson beam in the atm sphere (Ehmert, Lyons, Kulenkampff) and und great depths of water, on the heavy particles arisin in nuclear explosions (Euler, Flügge, Bagge, Ortne and neutron diffusion in the atmosphere (Flügge and on the relationship of nuclear diffusion "Stosse." (*b*) Scattering of charged particles, wi special reference to extensive cosmic ray showe (G. Moliere). Summarizes the author's work in th subject, connecting it with the shower analysis Landau and the early scattering treatment of Eul and Wergeland. (*c*) The relationships of the cosm ray particles (K.-H. Höcker). The basic scheme development of cosmic ray phenomena from proto primaries is set out. [See later work by Höcke Abstr. 3377, 3378 (1948), 7120 (1949)]. (*d*) Exper mental work on cosmic rays (A. Ehmert). Describe experimental work on atmospheric attenuation (fc small showers by Regener and Ehmert, for meson by Ehmert); on the mass of the meson (Steinmaurer on the lifetime of the μ-meson (Weisz, Brackert Juilfs, Barnothy and Forro, Kolhörster and Matther Ehmert, Seigert); on the secondaries of μ-meson (Stuhlinger, Ozorai and Forro, Ehmert, Leisegang on penetrating non-ionizing radiation (Barnoth and Forro); on atmospheric showers (Weber, Geige and Stubbe); on bursts (Stösse) (Steinke, Hoffma and Wilmers, Schmid) and their transition effect (Hoffmann, Steinke and Schmid, Stuhlweissenberg Rakuttis); on nuclear disintegration, mainly in photo graphic emulsions (Schopper, Wambacher, Stetter and on time variations of cosmic ray intensity (Rau Ehmert, Sittkus). J. G. WILSO

537.591 : 538.

6595. The magnetic deviation of cosmic-ray particle in the atmosphere. W. F. G. SWANN. *Phys. Rev.*, 7 243–6 (*May* 1, 1950).

The paper concerns the possibility of the path of cosmic-ray α-particle, proton, or mesotron bein bent in the atmosphere by the earth's magnetic fie

ch a manner as to pass vertically upward through
unter telescope. In order to pass vertically
rd through the telescope, it is necessary for the
o have been horizontal at some time during its
; and taking into account the minimum energies
ssitated by absorption along the path, it appears
for a telescope at an altitude comparable with
000 ft, neither an α-particle nor a proton would
"vertical room" between the telescope and the
to describe the angle ($\pi/2$) necessary to take it
the horizontal to the vertical upward direction.
a mesotron there would be room, but in this
the mesotron" mean life" operates to prevent the
nomenon happening in appreciable degree; it is
vn that regardless of energy or the law of energy
only a fraction $e^{-11\cdot6}$ of any assigned number of
otrons can live long enough to travel through a
t angle in the earth's magnetic field. A.

537.591 : 539.18

5. Note on varitrons. S. HAYAKAWA. Letter in *Progr. Theor. Phys.*, **5**, 145–7 (*Jan.–Feb.*, 1950).

Many observations have been reported which are
n to indicate the existence of several charged
ons different from π- and μ-mesons. An un-
cal survey is made of all these varitrons, and the
tions between them discussed. E. P. GEORGE

537.591 : 539.185

7. A temporary increase in the neutron component of cosmic rays. N. ADAMS. *Phil. Mag.*, **41**, 4–5 (*May*, 1950).

Observations of total ionizing cosmic ray intensity
of neutron intensity at Manchester during the
iations of Nov. 19, 1949, reported by Forbush
al. [*Bull. Amer. Phys. Soc.*, **25**, 15 (1950)] are
cribed. The total intensity showed a maximum ∼
12% and fell to ∼ + 1% in about 2 hr. The
tron intensity measured in a graphite pile, accept-
up to about 10 MeV and with maximum at 3 to
MeV, showed an increase of + 550% and was
nificantly above normal for upwards of 12 hr.
J. G. WILSON

537.591 : 539.185

8. A temporary increase in the neutron component of cosmic rays. N. ADAMS AND H. J. J. ADDICK. *Phil. Mag.*, **41**, 505 (*May*, 1950).

The large increase of neutron intensity [Abstr. 7] cannot be due to a direct flux of neutrons from sun, since the increase is still large after sunset, agreement with the absence of increase of total ensity at the equator. The effect must arise from arged primaries of momentum between the geo-gnetic limits at Manchester and the equator BeV/c–10 BeV/c), and the relatively small increases total intensity suggest that most of the abnormal x was in the lower part of this range. J. G. WILSON

537.591.1

99. Cosmic-ray induced nuclear disintegrations 11,000 meters. H. H. FORSTER. *Phys. Rev.*, **78**, 7–50 (*May* 1, 1950).

The equivalent absorption depth in air of the star-producing radiation is determined as 125 ± 8 g/cm² means of the photographic emulsion technique. e energy spectrum of α-particles emitted in nuclear disintegrations is obtained. It is found that the fraction of the number of stars with given prong number to the total number of disintegrations is not strongly dependent upon altitude up to elevations of 11 000 m. The contribution of different cosmic-ray particles to star production is discussed. Electrons, photons and light mesons are ruled out as the major agency for star production from consideration of their altitude dependence, π-mesons from consideration of lifetime and momentum. The results are shown to be consistent with the assumption of neutrons as the main star-producing agency. However, the fact that the penetrating showers also decrease exponentially with an absorption depth of 123 g/cm² suggests that the star-producing particle may be a by-product of penetrating showers, in which case the absorption depth of 125 g/cm² would be a measure of the creation rather than of the absorption of the star-producing radiation. A.

537.591.1

6600. Cloud-chamber observations of the new unstable cosmic-ray particles. A. J. SERIFF, R. B. LEIGHTON, C. HSIAO, E. W. COWAN AND C. D. ANDERSON. *Phys. Rev.*, **78**, 290–1 (*May* 1, 1950).

Thirty-four "forked tracks" similar to two previously reported by Rochester and Butler have been observed in 11 000 cloud-chamber photographs of cosmic-ray penetrating showers, confirming their conclusion that new unstable neutral and charged particles exist. The lifetime of the neutral particles is found to be about 3×10^{-10} sec, and some information as to the nature of the decay products is given. A.

537.591.15

6601. A note on the mixed shower. S. OGAWA. Letter in *Progr. Theor. Phys.*, **5**, 138–9 (*Jan.–Feb.*, 1950).

537.591.15 : 539.172.13

6602. Meson generation spectrum. E. CLEMENTEL. *Nuovo Cim.*, **7**, 109–17 (*March*, 1950) *In Italian.*

The energy spectrum of the mesons and secondary nucleons generated by the impact of a fast nucleon with a nucleus is calculated under the hypothesis of single successive acts of emission, and assuming that the cross-section for this phenomenon depends only on the relative energies. The frequency of penetrating showers deduced from this spectrum is compatible with experimental data. L. PINCHERLE

537.591.3

6603. Excess of positive mesons in cosmic rays. D. E. CARO, J. K. PARRY AND H. D. RATHGEBER. Letter in *Nature, Lond.*, **165**, 688–9 (*April* 29, 1950).

Particles capable of penetrating 10 cm Pb were selected by a 3-fold counter telescope, and deflected by a magnetic field of maximum value 13 500 gauss. The +/− ratio was found to increase slowly with momentum in the range $3\cdot10^8$ to $5\cdot10^{10}$eV/C. The momentum spectrum of 4 000 particles is given, and is found to depart from the expected curve at high energies. E. P. GEORGE

537.591.5

6604. The cosmic-ray intensity above the atmosphere at the geomagnetic equator. J. A. VAN ALLEN AND A. V. GANGNES. *Phys. Rev.*, **78**, 50–2 (*April* 1, 1950).

By means of G-M counter telescopes in an Aerobee

sounding rocket, total charged particle cosmic-ray intensity above the atmosphere has been measured at the geomagnetic equator. An empirical zenith angle (θ) dependence of directional intensity, averaged over all azimuths, is found to be $j(\theta) = 0{\cdot}028\,(1 + 0{\cdot}6\sin\theta)$, in which $j(\theta)$ is in absolute units (sec cm^2 steradian)$^{-1}$. The deduced vertical intensity 0·028/sec/cm^2/steradian is thought to be most nearly free of atmospheric albedo and, therefore, to be the best estimate of an upper limit for the primary intensity of charged particles of energy > 14 BeV (for protons). A comparison is made with previous results at geomagnetic latitude 41°N. A.

537.591.5

6605. Interpretation of underground cosmic-ray data. K. Greisen. Letter in *Phys. Rev.*, **78,** 65 (*April* 1, 1950). [See Abstr. 3240 (1950)].

537.591.5

6606. Altitude variation of zenith angle distribution of the hard component. A. Voisin. *C.R. Acad. Sci., Paris,* **230,** 1396–8 (*April* 12, 1950) *In French.*

The zenith angle distribution for particles traversing 14 cm Pb without multiplication is measured at Meudon (148 m altitude) to be $I = I_0 \cos^{2\cdot18\pm0\cdot02}\theta$ and at Pic du Midi (2,860 m altitude) to be $I = I_0 \cos^{2\cdot20\pm0\cdot04}\theta$. J. G. WILSON

537.591.5

6607. The latitude and longitude effects in cosmic rays over the United States and Canada at 30,000 feet. A. T. Biehl and H. V. Neher. Letter in *Phys. Rev.*, **78,** 172 (*April* 15, 1950).

537.591.5

6608. On the sudden increase in cosmic ray intensity on November 19, 1949. D. C. Rose. Letter in *Phys. Rev.*, **78,** 181–2 (*April* 15, 1950).

The increase at Ottawa was ~ 80%, while at Resolute (mag. lat. 83°) it was ~ 15%. Comparison with results from other stations for the same date confirm that sudden increments of intensity occur over a limited area. E. P. GEORGE

537.591.5

6609. The cut-off in the energy spectrum of primary cosmic radiation. P. J. D. Gething. *Phil. Mag.*, **41,** 495–9 (*May*, 1950).

Janossy's explanation of the cut-off in the observed cosmic ray energy spectrum, viz., that it is due to the action of the Sun's magnetic field, was originally based on Hale's estimate for the dipole moment of the Sun. A recent investigation by Thiessen, however, has led to a much smaller estimate. It appears that, if Janossy's calculations were corrected to allow for this new estimate, the calculated level of the cut-off would be greatly reduced, and consequently there should be a corresponding increase in the total intensity of incoming radiation observable at high magnetic latitudes. The possibility of an alternative explanation of the cut-off is considered, with particular reference to the theories of Milne and Fermi. A.

537.591.5

6610. The E–W asymmetry for isolated cosmic ray tracks in emulsions. H. Moucharafyeh, M. Morand and S. Rebaud. *C.R. Acad. Sci., Paris,* **230,** 834–6 (*Feb.* 27, 1950) *In French.*

Tracks ending in the emulsion of Ilford (C3 + B) plates exposed at 4 500 m in 1°s geomagnetic latitu were used to determine the contribution of μ-meso to the observed E–W asymmetry. It is conclud that the contribution of μ-mesons is small. J. G. WILS

537.591.5 : 523.

6611. Solar magnetic moment and diurnal variati in intensity of cosmic radiation. K. Dwight. *Ph Rev.*, **78,** 40–9 (*April* 1, 1950).

The effect of the earth's magnetic field upon t orbits of primary cosmic-ray particles is computed detail for the special case of those particles arriv vertically anywhere on the earth's surface. A p cedure is evolved for taking this deflection in co junction with the previous deflection in the magne field of the sun, and thereby calculating for any giv cosmic-ray energy spectrum an expected diurn variation in total cosmic-ray intensity. Examples this procedure are given for an inverse power spectr applied to two different magnitudes of the sol magnetic moment. The sample calculations are ma for several latitudes of observation, and the expect diurnal variation is then studied as a function of t solar magnetic moment and of the energy spectru The phase of the variation is found to be very sensiti to the solar moment, and so it is hoped that a su cessful experimental determination of the diurn variation will settle the question of the existence a magnitude of a permanent solar magnetic moment.

537.591.5 : 523.7

6612. Cosmic-ray intensity following a solar flar J. W. Broxon and H. W. Boehmer. *Phys. Rev.*, **7** 411–14 (*May* 15, 1950).

Continuous records of the cosmic-ray intensi measured by a heavily shielded, high pressure io chamber, were obtained during and following a intense solar flare (of importance 3+) and a subs quent intense magnetic storm. No increase in c-r i tensity was observed at or near the time of the flar such as have been observed by others on simil occasions. At the peak of the magnetic storm the was a decrease of about 1·5% in c-r intensity, wi full recovery requiring 2 or 3 days. Unshielded c telescope readings of low accuracy are include These indicate that there were no prolonged alter tions in the intensity (without shielding) of magnitud much greater than 14% associated with either th flare or the storm.

537.591

6613. The transition effect of the positive excess slow mesons. G. B. Zhdanov and A. A. Khaĭdarov *Dokl. Akad. Nauk, SSSR,* **71** (*No.* 1) 33–5 (1950 *In Russian.*

μ-mesons stopping in C and Al were recorded b delayed coincidence methods, from which the positiv excess, δ, was deduced. The change of δ with thickne of Pb absorber over the counter telescope w observed, and interpreted in terms of π-meso production in the absorber. E. P. GEORG

537.591.

6614. Note on the very large cosmic-ray star Y. Fujimoto and Y. Yamaguchi. *Progr. Theo Phys.*, **5,** 76–81 (*Jan.–Feb.*, 1950).

Fission theory is extended to high excitation. Th

sion of heavy fragments in large stars is taken to an example of fission. These fragments may etimes break up, giving rise to the asymmetric ps of α-particles reported to occur in large stars.
E. P. GEORGE

537.591.8

5. On the origin of electronic rays with moderate energy. Y. FUJIMOTO AND S. HAYAKAWA. er in *Progr. Theor. Phys.*, **5**, 144–5 (*Jan.–Feb.*,).

he frequency of 10 BeV electrons produced by nary protons is calculated as a function of atmoeric depth. The alternative mechanisms of neutral meson decay into 2 γ-rays, or (*b*) γ-iation following charge exchange of incident ton, are considered. The relevant experimental lts on bursts are not found sufficiently consistent make a useful comparison with the calculations.
E. P. GEORGE

537.591.8

6. Excess electrons in lower atmosphere and ecay of neutral mesons. S. HAYAKAWA. Letter in gr. *Theor. Phys.*, **5**, 158–9 (*Jan.–Feb.*, 1950).

537.591.8

7. On the interaction between nuclear-vibrational l electronic states. H. NARUMI AND Y. TAKANO. tter in *Progr. Theor. Phys.*, **5**, 160–2 (*Jan.–Feb.*, 50).

537.591.8

18. Erratum: Evidence for multiple meson and ay production in cosmic-ray stars. M. F. KAPLON, BRADT AND B. PETERS. Letter in *Phys. Rev.*, **78**, (*April* 1, 1950).—See Abstr. 3252 (1950).

537.591.8

19. Stars and showers at balloon altitudes. M. THORNDYKE AND A. W. WOTRING. Letter in ys. *Rev.*, **78**, 473–4 (*May* 15, 1950).

313 random expansions were made in a cloud amber containing 1 C and 3 Pb plates, flown at 000 ft from Minnesota. 66 events were observed which 21 were stars with 2 or more heavy tracks. of these stars had showers of 3 or more lightly nizing tracks, probably mesons. The remaining events are showers accompanied by 0 or 1 heavy acks, of which it is estimated that 16 originate in nclear explosions and 29 do not. These 29 showers e in general too small to have been caused by ergetic primary electrons, and it is concluded that imary electrons are rare or non-existent and in any se much less than 10% of the primary proton mponent.
E. P. GEORGE

537.591.8

20. Cosmic-ray bursts in ionization chambers of fferent materials. H. W. LEWIS. Letter in *Phys. ev.*, **78**, 483–4 (*May* 15, 1950).

Three fast ion chambers were made with Al, Cu nd Pb walls respectively. Bursts in the size range 5 to 3·0 Po-α were recorded. A counter system elow the chambers showed that 3% of the events in l and Cu and 15% of the events in Pb were due to owers. The remaining events are ascribed to stars, nd assuming the number/size distribution is the me for the three materials, the cross-section for star roduction is shown to vary as $A^{\frac{2}{3}}$.
E. P. GEORGE

537.591.8

6621. The intensity of primary heavy nuclei in the stratosphere at night. J. J. LORD AND M. SCHEIN. Letter in *Phys. Rev.*, **78**, 484–6 (*May* 15, 1950).

537.591.8 : 539.172

6622. Nuclear transmutations produced by cosmic-ray particles of great energy. IV. The distribution in energy, and the secondary interactions of the particles emitted from stars. U. CAMERINI, P. H. FOWLER, W. O. LOCK AND H. MUIRHEAD. *Phil. Mag.*, **41**, 413–28 (*May*, 1950).

The measurements of "multiple scattering" and "grain density" discussed [Abstr. 6317 (1949); 1060, 3235 (1950)], have now been extended to include a total of 1 000 tracks of particles associated with "stars." The method of measurement and the criteria for the selection of tracks were similar to those described previously. The new material provides additional evidence in support of the view that most of the mesons ejected from nuclear explosions with kinetic energy less than 150 MeV are π-particles. The distribution in energy of the ejected mesons, protons, deuterons and tritons has been determined, and it is shown that the "spectrum" for the mesons is in good agreement with that calculated by Sands [Abstr. 4198 (1950)]. The mean free path for nuclear interaction of the various types of particles in passing through the emulsion has been determined. The value obtained for mesons corresponds to a cross-section for the interaction equal to the "geometrical" value.
A.

537.591.8 : 550.37

6623. Cosmic radiation and the maintenance of a potential gradient in the atmosphere. R. E. HOLZER. Letter in *Phys. Rev.*, **77**, 846 (*March* 15, 1950).

Examining a recent suggestion as to the maintenance of the earth's electric field [Abstr. 4504 (1950)], it is shown that, near the earth surface, the suggested mechanism produces a gradient of opposite polarity to that actually observed and that the discharge current postulated is a minute fraction of the current amplitude measured.
R. H. GOLDE

MAGNETISM 538

538.082.74

6624. A saturated core recording magnetometer. D. C. ROSE AND J. N. BLOOM. *Canad. J. Res., A*, **28**, 153–63 (*March*, 1950).

A recording magnetometer operating on the saturated core inductor principle has been constructed. An inverse feed-back system supplies a current to neutralize the field being measured. The neutralization is such that the sensitive element is maintained within 2 or 3 gammas of zero field. The feed-back current is measured by a recording milliameter. Using a feed-back coil of suitable dimensions, the record gives a direct measure of the field.
A.

538.082.74

6625. A null-coil pendulum magnetometer. C. A. DOMENICALI. *Rev. Sci. Instrum.*, **21**, 327–9 (*April*, 1950).

A null-method magnetometer is described for the

measurement of magnetization of small single crystals of polycrystalline specimens of ferromagnetic materials. It may also be used for measurements on para- and diamagnetic materials. The specimen is placed in an inhomogeneous magnetic field inside a "null-coil" of known geometry, and the current through the coil is adjusted so as to reduce the net magnetic moment of coil and specimen to zero. This coil is rigidly attached to the lower end of a sensitive pendulum and the null-position of the pendulum is observed with the aid of a projection-microscope. This method eliminates the necessity of measuring the force on the specimen and the gradient of the magnetic field. The conditions are discussed under which the absolute error may be reduced to arbitrarily small values. The secondary field arising from the current in the null-coil is, in general, negligible; however, a simple method is described for its elimination. A.

538.1

6626. Ferromagnetism as Einstein condensation of Bloch spin waves. G. HÖHLER. *Ann. Phys., Lpz.*, 7 (*No.* 1–2) 93–6 (1950) *In German.*

The relation between the two theoretical ideas is discussed generally. Osborne's discussion [Abstr. 933 (1950)] on thin He films is considered in the light of this relation, and it is shown that ferromagnetic films may be a possibility in the spin wave treatment, in contrast to Bloch's original conclusion.

E. P. WOHLFARTH

538.1 : 538.22

6627. Antiferromagnetism and intermittent activation in Fe–Cr and Fe–V alloys. R. FORRER. *C.R. Acad. Sci., Paris*, **230,** 1584–5 (*May* 3, 1950) *In French.*

Discusses the variation of saturation moment with Cr and V concentration from a theoretical point of view. E. P. WOHLFARTH

538.11

6628. On the theory of linear effects. K. P. BELOV. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 2) 261–4 (1950) *In Russian.*

The theory leads to the law: at saturation the $\|$ effect is twice the $\perp$ effect and bears the opposite sign. This law only holds provided (i) 4th order terms are small in the tensor of anisotropy, (ii) the para process is absent, (iii) no magnetic texture exists. At the Curie point the law of anisotropy changes and for alloys with low Curie points $\alpha\|$ and $\alpha\perp$ will be approximately equal and of equal sign. As the Curie point is approached linear effects must increase with the increasing para process. As the temperature decreases from the Curie point inversion and rotation begins so that the $\alpha\|$ and $\alpha\perp$ curves separate while their slopes, which are determined by the para process, decrease. If away from the Curie point $\alpha\| \neq -2\alpha\perp$, the 4th order terms in the anisotropy tensor are probably large. J. JACOBS

538.114

6629. Experimental proofs of ferrimagnetism and of antiferromagnetism. L. NÉEL. *Ann. Inst. Fourier*, **1,** 163–82 (1949).

Observations on the saturation molecular moment of ferrites, both pure and mixed, are presented in support of the author's theory of the ferromagnetic properties of these materials. The case of Cu ferrite is treated in detail. Neutron diffraction experime have confirmed that antiferromagnetic materials based on 2 sub-lattices, the ions on which are oppositi magnetized, and it is shown that the ferrites (fe magnetics) are a special case of antiferromagnetis The existence of super-exchange forces between me atoms via an intervening O atom is also discussed.

A. E. DE BA

538.1

6630. On the ferromagnetism of the ferrites, ferrimagnetism. L. NÉEL. Letter in *Physica*, 350–2 (*March*, 1950) *In French.*

Suggests that a recent theory of the magne properties of ferrites [Abstr. 1859 (1950)] does explain the observed phenomena and that the autho own explanation, in terms of the existence of negati exchange integrals between ions on different latt sites [Néel, *C.R. Acad. Sci., Paris*, **230,** 375 (1950 leads to better agreement with experiment.

A. E. DE BA

538.1

6631. Ferromagnetic resonance phenomena at micr wave frequencies. K. J. STANDLEY. *Sci. Progr.*, 231–45 (*April*, 1950).

A survey of the present position, with a discussi of the attempts to complete the basic theory Kittel. 18 refs.

538.1

6632. Concerning the theory of ferromagnet resonance absorption. J. H. VAN VLECK. *Phys. Re* **78,** 266–74 (*May* 1, 1950).

The first part of this paper gives a simple quantun mechanical derivation of Kittel's formula for th resonance frequency of ferromagnetic materials. TI interactions between the elementary dipoles a handled directly, rather than through the *ad hi* introduction of macroscopic demagnetization factor as is usually done. In Section 3, Kittel's correctio for the effect of anisotropy on frequency are derive from the microscopic standpoint with a model havin quadrupolar coupling between atoms. Section discusses qualitatively the effect of exchange narrowi on the line-width. In Section 5 it is shown tha Kittel's relation $g - 2 = 2 - g'$ connecting th spectroscopic splitting factor g and the gyromagnet ratio g' is a general consequence of first-ord perturbation theory. Throughout the paper it stressed that ferromagnetic bodies may have importa short-range forces of dipolar structure which aris from anisotropic exchange rather than from tru magnetic coupling. It is shown that in the firs approximation, inclusion of these anomalous force does not modify Kittel's results.

538

6633. Observed changes in the angle between th magnetic axis and the geometric axis of a bar magne A. M. VAN WIJK. Letter in *Nature, Lond.*, **165,** 726– (*May* 6, 1950).

Establishes that changes in the differences betwee the "magnet erect" and "magnet inverted" reading in declination measurements are wholly or partly du to changes in the angle between the magnetic an geometric axes of the magnet. H. P. MYER

538.2 : 538.55

. The transition between ferromagnetism and magnetism [in Ni]. F. FRAUNBERGER. *Z. Naturh.*, **5a**, 129–32 (*March*, 1950) *In German.*

he h.f. resistance was measured between 350° and c, in order to investigate the nature of the sition by observations on the skin effect. From measurements the temperature variation of the permeability was deduced. The experiments are d to provide evidence that the paramagnetic ie temperature, θ_p, is the "true" one. The tence of a transformation point at a temperature w θ_p is interpreted by assuming an increase of Weiss molecular field coefficient at and above θ_p.

E. P. WOHLFARTH

538.21

5. Ferromagnetic phenomena at microwave frencies. G. T. RADO. *Adv. Electronics*, **2**, 251–98 50).

survey of the principal results and most sigcant considerations of recent developments. perimental microwave technique is not included. efs.

538.21 : 538.27

6. Determination of the apparent permeability of the Q factor of a magnetic powder at high quencies. A. COLOMBANI. *J. Phys. Radium*, **11**, –7 (*May*, 1950) *In French.*

he apparent permeability and Q factor for a wder composed of isolated spherical magnetic ticles are calculated as a function of the frequency he applied field. The results obtained are said to in agreement with observation.

A. E. DE BARR

538.22

7. Ferromagnetic platinum-manganese alloys. AUWÄRTER AND A. KUSSMANN. *Ann. Phys., Lpz.*, *No.* 3–4) 169–72 (1950) *In German.*

The alloys exhibit ferromagnetism in the concentran range 6–16% Mn (by weight) with max. saturation gnetization ($4\pi J_0 = 8\,000$) at 9% Mn (25% Mn mic). This is ascribed to an ordered Pt_3Mn phase. gnetization-temperature curves, lattice constants, rmal expansion coefficients and order-disorder d Curie temperatures were measured, and the effects heat treatment investigated. The ordered phase is nd to be formed below about 900°C; further, for oys with above 14% Mn phase segregation takes ce with a sharp increase of the coercive force.

E. P. WOHLFARTH

538.22

38. Magnetic properties of platinum–iron alloys. II. KUSSMANN AND G. v. RITTBERG. *Ann. Phys., Lpz.*, *No.* 3–4) 173–81 (1950) *In German.*

Further investigations [L. Graf and A. Kussmann, *ys. Z.*, **36**, 544 (1935)] lead to the following novel sults: For alloys with 50–63% Pt (by weight) anges of saturation magnetization and Curie point re observed consequent on the formation of an $_3$Pt superlattice. In this concentration range very gh values of the magnetostriction coefficient were served, viz. $\Delta l/l = 180\times10^{-6}$ at 62% Pt and a ld change above saturation of about 40×10^{-6} per 1 000 oersted at 57% Pt. Optimum permanent magnet properties were observed at about 70% Pt, with $_JH_C = 1\,900$ oersted, $B_R = 6\,000$ gauss, $(BH)_{max} = 3\cdot3\times10^6$. Here $\Delta l/l$ is only about 2×10^{-6}. In a restricted concentration range (94–98% Pt) ferromagnetism is again observed in spite of low iron content.

E. P. WOHLFARTH

538.22

6639. Magnetic properties of oxygen adsorbed on active charcoal at high temperatures. C. COURTY. *C.R. Acad. Sci., Paris*, **230**, 1588–9 (*May* 3, 1950) *In French.*

Experimental measurements show that the paramagnetic susceptibility of O_2 decreases during adsorption on charcoal at 900°C, the decrease being of the same order as in previously reported experiments at room temperature. [*C.R. Acad. Sci., Paris*, **218**, 832 (1944)].

E. P. WOHLFARTH

538.22 : 538.24

6640. Magnetization in ferrites. Saturation magnetization of ferrites with spinel structure. E. W. GORTER. *Nature, Lond.*, **165**, 798–800 (*May* 20, 1950).

Various single ferrites as well as their mixed crystals with Zn ferrite were investigated. The measured saturation magnetization, M_s, is compared with the sum of the ionic moments and found to be much smaller, but to agree well with $gS_{Me}{}^{++}$ (for a ferrite $MeFe_2O_4$), in accordance with Néel's ideas [Abstr. 3388 (1948)]. For the mixed crystal ferrites the experimental variation of M_s with Zn ferrite concentration is compared with theoretical curves (assuming the signs of the various exchange integrals involved). Residual discrepancies are discussed.

E. P. WOHLFARTH

538.22 : 538.24

6641. Thermal variation of the spontaneous magnetization of the ferrites of nickel, cobalt, iron and manganese. R. PAUTHENET. *C.R. Acad. Sci., Paris*, **230**, 1842–3 (*May* 22, 1950) *In French.*

This was investigated experimentally, using the axial extraction method and fields up to 2×10^4 oersted. The Curie temperature and absolute saturation magnetization were measured and the law of approach to 0°K determined; this is a T^2 law for the Ni, Co and Fe ferrites and a $T^{3/2}$ law for the Mn ferrite. Reduced σ–T curves are shown and indicate that the law of corresponding states is far from being obeyed.

E. P. WOHLFARTH

538.22 : 538.24

6642. A new series of ferromagnetic substances: the ferrites of rare earth metals. H. FORESTIER AND G. GUIOT-GUILLAIN. *C.R. Acad. Sci., Paris*, **230**, 1844–5 (*May* 22, 1950) *In French.*

These ferrites are described by the general formula $Fe_2O_3 \cdot M_2O_3$, where M represented, in these experiments, one of the rare earth metals La, Pr, Nd, Sm, Er, Y. The method of preparation is described, and magnetization-temperature curves are shown. Curie temperatures were found to range from 738°K (La) to 548°K (Y). Saturation magnetization values were found to be low compared with that of nickel ferrite; there is an approximate inverse relation

between σ_0 and θ. The La and Pr ferrites exhibit strong thermo-remanence. E. P. WOHLFARTH

538.22 : 538.55

6643. Magnetization in ferrites. *g*-factors in ferrite materials. H. G. BELJERS AND D. POLDER. *Nature, Lond.*, **165**, 800 (*May* 20, 1950).

Measurements were carried out on Ni–Zn ferrites with various values of the Ni/Zn ratio, by ferromagnetic resonance absorption methods, using a 3·2 cm wavelength and spherical specimens. For a 2 mm sphere the magnetization was believed to be uniform, giving reasonably accurate *g*-values. A variation of *g* from 2·23 to 1·88 was observed as the NiO concentration decreases from 50% to 11%. As interpretation it is suggested that in the pure Ni ferrite only Ni ions contribute to the ferromagnetism, while in the Ni–Zn ferrites ferric ions also contribute.

E. P. WOHLFARTH

538.22 : 548.73

6644. Relation between the crystal structure and magnetic properties of mixed nickel–zinc ferrites. M. SAGE AND C. GUILLAUD. *C.R. Acad. Sci., Paris*, **230**, 1751–3 (*May* 15, 1950) *In French.*

X-ray investigation indicates how the Ni and Zn ions are distributed among the available lattice sites *A* and *B* as the proportion of Fe_2O_3 . NiO changes. These results may be used to interpret the magnetic properties of the ferrites [*C.R. Acad. Sci., Paris*, **229**, 1133 (1949)]. E. P. WOHLFARTH

538.221

6645. Magnetic after-effect induced by means of mechanical shock. L. LLIBOUTRY. *C.R. Acad. Sci., Paris*, **230**, 1586–7 (*May* 3, 1950) *In French.*

An experimental study indicates the effectiveness of shock in producing a magnetic after-effect. Parameters introduced in theoretical work of Néel [Abstr. 4211 (1950)] were measured for a range of values of the field and the magnitude of the impulse, and the results are discussed in the light of a theoretical study by Brown [Abstr. 2600 (1949)]. E. P. WOHLFARTH

538.221 : 537.312.6 : 536.48

6646. Magnetic and electric properties of natural and synthetic single crystals of magnetite. C. A. DOMENICALI. *Phys. Rev.*, **78**, 458–67 (*May* 15, 1950).

When a crystal of magnetite has been cooled through the low temperature transition (near −164°c) in a demagnetized state, the magnetization undergoes a large and abrupt increase in the 3 principal crystallographic directions [100], [110] and [111] upon warming. The behaviour of the magnetization upon cooling in a magnetic field is influenced by crystallographic orientation as well as by the strength of the applied field. The form of the magnetization curve at temperatures below the transition depends on the crystallographic direction and on the magnetic treatment of the specimen while cooling through the transition. Barkhausen experiments lead to tentative ideas concerning domain orientation. Significant information concerning the nature of the transition was also obtained from measurements of thermal expansion and saturation magnetostriction. The magnetic effects in the low temperature transitio region appear to be influenced by the establishment o internal stresses which cause a "freezing-in" c preferential domain directions below the transitio region. The stress and domain pattern resultin appears to depend on the magnetic treatment of th crystal during its passage through the transitio region. The temperature dependence of the electrica resistivity is in agreement with the results of Verwe and de Boer for sintered magnetite. Some preliminar observations are reported on the effects of magneti fields on the resistivity.

538.221 : 538.24

6647. Influence of annealing on the remanen magnetization of ferromagnetics. J.-C. BARBIER. *C.R. Acad. Sci., Paris*, **230**, 1643–5 (*May* 8, 195 *In French.*

It is shown that the square root of the remanen magnetization, measured at temperature T_0, i proportional to $(T - T_0)$, where T is the temperatur of anneal ($T > T_0$). The results are explained i terms of thermal fluctuations [see Abstr. 4211 (1950)]

A. E. DE BAR

538.221 : 548.

6648. Ferromagnetic resonance absorption in mag netite single crystals. L. R. BICKFORD, JR. *Phys. Rev.* **78**, 449–57 (*May* 15, 1950).

The microwave resonance absorption technique, a both 1·25 and 3·3 cm wavelengths, was used to stud the ferromagnetic crystalline anisotropy charac teristics and *g*-factor of magnetite Fe_3O_4. The experiments were performed on single crystals, both synthetic and natural, from room temperature t −195°c. Depending upon the temperature, mag netite single crystals were found to have magnetic anisotropy characteristics similar to those of single crystals of the 3 ferromagnetic elements. From room temperature to −143°c, they behave like Ni; between −143° and the transition which magnetite is known to undergo at *ca.* −160°c, like Fe; and below the transition, somewhat like Co. At room temperature values of $g = 2{\cdot}12$ and K_1 (first-order anisotropy constant) $= -1{\cdot}10 \times 10^4$ joule/m³ ($-1{\cdot}10 \times 10^5$ erg/cm³) were obtained. It was found that below about 90°c the absolute value of K_1 decreases with decreasing temperature, reaching zero at *ca.* −143°c. Between −143° and the transition K_1 is positive and increases with decreasing temperature. The vanishing of crystalline anisotropy at −143°c accounts for the peak in initial permeability found near this temperature. The *g*-value was found to decrease gradually and monotonically with decreasing temperature. The behaviour of magnetite in the resonance experiments below the transition seems to indicate that the magnetic symmetry is uniaxial in this temperature region. This conclusion is consistent with the findings of other investigators. Below the transition the magnetic axis is that [100] direction most nearly parallel to a strong magnetic field applied to the crystal as it is cooled through the transition. A temperatures not far below the transition it is possible to change the magnetic axis from one [100] direction to another by means of a strong magnetic field.

538.221 : 548.73

gnetic properties and structure of the tetragonal of Cu ferrite. *See Abstr.* 6828

538.222 : 539.13

Influence of nuclear spin on the paramagnetic nce absorption in solutions of manganese and salts. S. A. ALTSHULER, B. M. KOZYREV AND SALIKHOV. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 5) (1950) *In Russian.*

low magnetic field strengths nuclear-spin/elec--spin coupling is preserved and magnetic ance effects corresponding to the resultant n may be observed. For $MnCl_2$ at 0·5 Mole/l in a sharp resonance peak for Mn^{++} at 180 oersteds 207 Mc/s is observed which corresponds to , which agrees with theory taking $I = 5/2$ $= 5/2$. At 3 Mole/l interionic fields destroy in coupling and an indistinct electronic resonance nd at 100 oersteds. For Cu^{++} $I = 3/2$, $J = 1/2$, oupling is weaker and several small resonance s are observed with 1·6 Moles/l of $Cu(NO_3)_2$ 69 Mc/s as the theory for intermediate field gths requires. Observations are made with ndicular static and high frequency measuring and absorption is observed by reaction on the ator. D. H. WHIFFEN

538.23 : 538.54

Magnetic properties of a manganese ferrite imen] in weak fields. C. GUILLAUD AND A. EZAT. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 11) 00 (1950) *In French.*

easurements were carried out of the energy losses rring in a toroidal specimen of manganese ferrite n undergoing cyclic magnetization in the Rayleigh n at different frequencies. Simple theoretical iderations enable the observed losses to be ysed into a number of constituent components, ng from the ohmic resistance of the windings, currents, hysteresis and a residual loss, pro-ional to the inductance of the coil and the uency. E. P. WOHLFARTH

538.24 : 548.0

. Anisotropic property of iron single crystal e. III. Magnetization curve. E. TATSUMOTO AND HAHAKABE. *J. Sci. Hiroshima Univ.*, **14**, 50–1 *y*, 1949).

Magnetization curves for single crystal plates, Fujiwara [*J. Sci. Hiroshima Univ.*, **9**, 227 (1939)]; Fujiwara and E. Tatsumoto [*J. Sci. Hiroshima v.*, **13**, 235 (1944)] of silicon iron (Si 1·2%) along [100], [110] and [111] axes were determined and ked anisotropy found. H. P. MYERS

538.24 : 548.0

2. Anisotropic property of iron single crystal e. IV. Anisotropic constants of magnetization. TATSUMOTO. *J. Sci. Hiroshima Univ.*, **14**, 52–3 *y*, 1949).

Determines anisotropy constants for silicon iron stals containing: Si 3·4%: $K_1 = 3{\cdot}16\times10^5$ erg. $^{-3}$; $K_2 = 0{\cdot}97\times10^5$ erg. cm^{-3}. Si 1·2%: $K_1 = 4\times10^5$ erg. cm^{-3}; $K_2 = -0{\cdot}27\times10^5$ erg. cm^{-3}. e preceding Abstr. and H. J. Williams, *Phys. Rev.*, 747, 1004 (1937)]. H. P. MYERS

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3

6653. On the foundations of classical electrodynamics (axiomatic method). A. MERCIER. *Arch. Sci.*, **2** (*No.* 3) 584–8 (1949) *In French.*

A set of definitions and axioms is proposed for classical electromagnetic theory which has the advantage that proper account is taken of the influence of polarizable matter. An important deduction is that the Poynting vector must be defined as $E \times B$ and not $E \times H$. The choice of units is discussed.

A. T. PRICE

538.311 : 621.3.013.2

6654. Practical calculation of magnetizing force. A. A. HALACSY. *Proc. Instn Elect. Engrs, Pt I*, **97**, 37–42 (*March*, 1950).

Any vector component of the magnetizing force at a point in space due to an electric current is directly related to a vector representing the surface swept over by the radius vector of length $r^{-\frac{1}{2}}$ with its origin and direction the same as those of the radius vector r directed from the point in question to consecutive points on the path of the influencing current. This relationship enables magnetizing force, distribution of the magnetic field, electromagnetic forces, etc., to be calculated by means of simple geometry in all practical cases, including those in which no simple analysis has so far been possible. A.

538.56 : 535.1

Singular case of Huyghen's problem. *See Abstr.* 6333

538.56 : 535.1

Vector space for waves regular outside a closed surface. *See Abstr.* 6334

538.56 : 538.221

6655. A variational principle for the computation of reflection coefficients. G. TORALDO DI FRANCIA. Letter in *Phys. Rev.*, **78**, 298 (*May* 1, 1950).

538.565.4

6656. Damped harmonic motion. D. A. RICHARDS. *Amer. J. Phys.*, **18**, 222–6 (*April*, 1950).

Describes the use of a moving coil galvanometer to determine damping characteristics of an electrical oscillating system. Damping less than critical: damping ratio $\xi = \cos\delta = \alpha/\bar{\omega}$, where α = damping coeff., $\bar{\omega}$ = angular freq. when there is no damping. ξ is found firstly from ratio of successive swings: secondly from $\dot{\theta}_0$ the initial velocity through the equilibrium position, θ_1 the first throw, and $\bar{\omega}$. In the second method a value of $e^{\delta\cot\delta}$ is obtained from which ξ is found. Damping greater than the critical: the equations are in the hyperbolic form. Curves show errors involved in using approximation for log. dec., $\theta_1(1 + \lambda/2)$ instead of $\theta_1 e^{\delta\cot\delta}$; $\lambda = \log_e|\theta_r/\theta_{r+1}|$. Experimental details, circuits and testing procedure are given. A. B. EASON

538.566

6657. The geometrical locus of the reflection coefficient of e.m. waves, when the reflection is due to a discontinuity in the gradient of the dielectric constant, in the case of small gradients. G. ECKART. *C.R. Acad. Sci., Paris*, **230**, 1044–5 (*March* 13, 1950) *In French.*

538.566

6658. The laws of Fresnel in centimetric waves. J.-C. SIMON. *C.R. Acad. Sci., Paris*, **230**, 1386–8 (*April* 12, 1950) *In French.*

This note considers the diffraction effects of centimetric waves obtained with metal plates pierced with holes. Analogies with the classical optical theory are confirmed and, in particular, the Brewster effect is discussed in both its optical and electromagnetic aspects. R. W. FISH

538.566 : 535.23.08

6659. Absolute measurement of microwave power by radiation pressure. A. L. CULLEN. Letter in *Nature, Lond.*, **165**, 726 (*May* 6, 1950).

538.566 : 535.42 : 621.396.11

6660. Diffraction from an irregular screen with applications to ionospheric problems. H. G. BOOKER, J. A. RATCLIFFE AND D. H. SHINN. *Philos. Trans., A* (*No.* 856) 579–609 (1950).

An analysis is made of the diffraction effects produced when a plane wave is incident upon an irregular diffracting screen, and the results are applied to the problem of the reflection of radio waves from an ionosphere which is irregular in the horizontal plane. It is assumed that the nature of the screen is given in terms of the variation of electric wave-field in a plane just beyond the screen, and that variations occur over the plane in one direction only; that the screen is "random" in the sense that it is one of an assembly all of which differ from each other, but have statistical properties in common; and deductions are made about the diffraction patterns averaged over the assembly. Use is made of the theory of "random" electrical noise as developed by Rice and Uhlenbeck. The angular spectrum (Fraunhofer diffraction pattern) and the Fresnel diffraction pattern are described in terms of their spatial auto-correlation functions, and there is discussion of a related method of dealing with Fresnel diffraction problems from completely determined screens. The irregular "fading" exhibited by a radio wave returned from the ionosphere is discussed in terms of two models in which the fading is assumed to be produced by movements of the diffracting centres in the ionosphere. The temporal auto-correlation function of the amplitude of the irregularly fading signal is related to the velocity of the ionospheric diffracting centres. A.

538.566 : 621.396.677

6661. Survey of polar diagrams in the plane and in space. F. BERGTOLD. *Frequenz*, **4**, 114–17 (*May*, 1950) *In German.*

The basic directional properties of transmitting and receiving aerials are briefly discussed, and various polar diagrams (in space and in the plane) are drawn. A logarithmic method for measuring the intensity and angular variation of the radiation is described.

L. S. GODDARD (R)

538.566.2

6662. The refractive index and classical radiative processes in an ionized gas. K. C. WESTFOLD. *Phil. Mag.*, **41**, 509–16 (*June*, 1950).

The role of the refractive index in the classical theory of radiation in an ionized gas is investigated. The Lorentz formula for the macroscopic absorption coefficient is recovered from microscopic considerations, and the heuristic modification of the formula for the emissivity obtained in a previous paper [Abstr. 5893 (1949)] is justified. The consequent modification of the free-free transition probability is indicated.

MAGNETIC EFFECTS 538.6

538.

6663. Relation between magnetophotophoresis and ferromagnetism. P. TAUZIN AND A. LESPAGN *C.R. Acad. Sci., Paris*, **230**, 1853–5 (*May* 22, 19 *In French.*

Qualitative chemical analysis of particles exhibiting the Ehrenhaft phenomenon of magnetophotophore when suspended in a gas shows that the partic contain Fe or other ferromagnetic substances. T particles are oriented by even the smallest magne fields and are stated to have dipole rather than sim pole characteristics. The phenomenon disappe above the Curie temperature of the ferromagne constituent of the particles. E. P. WOHLFAR

538.6

6664. The influence of random elastic stresses on the law of approach to saturation. L. V. KIRENSKĬI A L. I. SLOBODSKOĬ. *Dokl. Akad. Nauk, SSSR*, (*No.* 5) 809–11 (1950) *In Russian.*

The intensity of magnetization is expressed in ter of b/H^2 and c/H^3 where H is the field streng Calculations of the coeffs. c, b are given under t assumption of uniformly distributed H. The si of the magnetostriction can be determined and lea to a knowledge of the sign of the mean value of f of polycrystalline samples, and conversely. J. JACC

538.652 : 537.22

The constants of magnetostrictive electro-acous convertors. *See Abstr.* 6485

538.669 : 536

6665. Thermodynamics of transverse thermomagne effects. J. E. VERSCHAFFELT. *Bull. Acad. R Belg., Cl. Sci.*, **35** (*No.* 3) 180–92 (1950) *In French.*

A discussion is given of the relation between t coefficients of the Ettingshausen and Ettingshause Nernst effects, previously considered by Bridgma Lorentz and others. The author considers it erroneo to regard the E effect as being accompanied by flow of heat with an associated evolution of hea It is shown that no such heat flow may arise witho the existence of a temperature gradient, and th thermodynamical arguments do not, in fact, lead any relation between the coefficients of the two effect E. P. WOHLFAR

MOLECULAR STRUCTURE 539.13

539.13 : 517

6666. Certain Fourier transforms and the structu of proteins. D. WRINCH. Letter in *J. Chem. Phy* **18**, 562–3 (*April*, 1950).

539.13.133

Quadrupole moment of the electron distribu- hydrogen molecules. N. F. RAMSEY. *Phys.* 78, 221–2 (*May* 1, 1950).

nolecular beam experiments on H molecules, rements have been made in the past both of tational magnetic moment and of the dependence diamagnetic susceptibility on the orientation e molecules' rotational angular momentum. shown in this paper that these 2 experimental s can be combined to give an experimental nination of the quadrupole moment of the on distribution in H molecules. The results of nalysis are that the mean value of $\Sigma_j(3z_j^2 - r_j^2)$ taken along the internuclear axis of the mole- is $(0{\cdot}38 \pm 0{\cdot}15) \times 10^{-16}$ cm². Alternatively, if axis is the axis of quantization, the mean value $(3z_j^2 - r^2)$ in the rotational state $M_J = J = 1$ $076 \pm 0{\cdot}030) \times 10^{-16}$ cm². The first figure can mpared to the value $0{\cdot}31 \times 10^{-16}$ cm² calculated the H molecular wave function by James and dge. Although the precision of the past urements is small, a gain of a factor of about 100 precision of this measurement should be possible some experiments now in progress. A.

539.132

. The principle of maximum overlapping. MACCOLL. *Trans. Faraday Soc.*, **46**, 369–74 , 1950).

suming that the overlap integral between 2 oms gives a measure of the bond dissociation gy of a hybrid bond involving C, it is found the bond strength of hybrid bonds increases in order $sp > sp^2 > sp^3$. Figures are given showing dependence of the overlap integral upon the state hybridization. Some general considerations rding the overlap integral and $s - p$ hybridization also given. A.

539.132

). Structure of *cyclo*-Octatetraene. B. D. SENA AND H. NARAIN. Letter in *Nature, Lond.*, 723 (*May* 6, 1950).

hree structures, viz. D_{4d}, D_4 and D_{2d}, have been posed for the above substance by various authors. analysis of the Raman and infra-red spectra ws that good agreement between calculated and erved frequencies is obtained assuming the onating structure D_{4d} to be correct, but the rnative, D_4, is not absolutely ruled out. J. IBALL

539.132

0. A note on the centrifugal stretching in axially metric molecules. H. H. NIELSEN. *Phys. Rev.*, 415–16 (*May* 15, 1950).

t is demonstrated that the degenerate Coriolis tting of a rotational level, $K \neq 0$, of a molecule ch is in an excited perpendicular vibration state nfluenced by centrifugal distortion. The effect is the form $aK^3 + bJ(J+1)K$. The effect of this ortion on the infra-red spectrum is of the same er of magnitude as the ordinary centrifugal dis- ion. It is further shown that by redefining the iolis coupling coefficient ζ_t the rotational energy of a symmetric molecule may be written in the form $(E/hc) = [J(J+1) - K^2]B_v + L^2C_v - [J(J+1) - K^2]^2D_J - [J(J+1) - K^2]L^2D_{JL} - L^4D_L$ where $L = K - \Sigma_t l_t \zeta_t^{(z)}$. A.

539.132 : 535.338.42

6671. Forbidden transitions in diatomic molecules. I. The quadrupole rotation-vibration spectrum of H_2. G. HERZBERG. *Canad. J. Res. A*, **28**, 144–52 (*March*, 1950).

Four lines of the 2–0 band and four lines of the 3–0 band of the quadrupole rotation–vibration spectrum of H_2 have been observed and measured using effective absorbing paths of 10 to 50 km atm. From this spectrum improved values of the rotational and vibrational constants of H_2 in its electronic ground state have been obtained. A.

539.132 : 535.343–14

6672. Microwave determination of the structure of chloroform. R. R. UNTERBERGER, R. TRAMBARULO AND W. V. SMITH. Letter in *J. Chem. Phys.*, **18**, 565–6 (*April*, 1950).

539.132 : 541.57

6673. Bond energies and bond lengths. H. C. LONGUET-HIGGINS. *Nature, Lond.*, **165**, 908–11 (*June* 10, 1950).

Report of a Royal Society discussion, March 9, 1950. Eleven papers, and the discussion thereon, are briefly reported.

539.133

6674. Some developments of Guggenheim's simplified procedure for computing electric dipole moments. J. W. SMITH. *Trans. Faraday Soc.*, **46**, 394–9 (*May*, 1950).

Based on the treatment suggested by Guggenheim, a method has been devised which permits the calculation of the apparent orientation polarization and dipole moment of a polar solute in a non-polar solvent without the necessity of measuring the densities of the solutions. For aniline in various solvents the results are within 0·15 cm³ and 0·002 D, respectively, of the values derived from the same data by the conventional method. A slight modification of Guggenheim's "further simplification" also leads to results which differ little from those deduced by the usual method except when the value of the dielectric constant of the solvent differs considerably from the square of its refractive index. A.

539.133

6675. On the evaluation of electric dipole moments. K. B. EVERARD, R. A. W. HILL AND L. E. SUTTON. *Trans. Faraday Soc.*, **46**, 417–23 (*May*, 1950).

The evaluation of the dipole moment of a substance from measurements of the dielectric constants, specific volumes and refractive indices of its dilute solutions in a non-polar solvent is discussed. The desirability of separately evaluating the total and the electron polarizations is considered, and difficulties in measuring the latter are discussed.

539.133 : 535.343.4–15

6676. The infra-red spectrum and structure of ozone. H. S. GUTOWSKY AND E. M. PETERSEN. Letter in *J. Chem. Phys.*, **18**, 564–5 (*April*, 1950).

ATOMIC STRUCTURE : ISOTOPES 539.15

539.152.1

6677. On the low states of Li^7 and Be^7. D. R. Inglis. Letter in *Phys. Rev.*, **77**, 724–5 (*March* 1, 1950).

The interpretation of the experimentally observed levels of Li^7 and Be^7 is discussed using the *j–j* coupling scheme. More experimental data is needed to verify the proposed level scheme. J. HUGHES

539.152.1

6678. Some experiments on the nuclear isomerism of ^{80}Br. G. Kayas. *J. Phys. Radium*, **11**, 195–8 (*April*, 1950) *In French.*

Some preliminary experiments are described which indicated that the ground state and the isomeric state exist in different chemical states probably due to the internal conversion of the γ-ray from the isomeric state. A method is developed using anion exchange with a synthetic resin (amberlite IR 4B), which preferentially takes up the ground state.

J. HUGHES

539.152.1

6679. Nuclear abundances and closed shells in nuclei. R. A. Brightsen. *Nucleonics*, **6**, 14–24 (*April*, 1950).

A review of the evidence for the existence of shell structure in the atomic nucleus. Data on abundances and nuclear stability are set out to support the case for the presence of closed shells, corresponding to certain numbers of neutrons and protons. Evidence is produced, suggesting that the closed shell numbers for protons are not all the same as those for neutrons.

L. R. SHEPHERD

539.152.1

6680. On a well-known cross-section theorem. M. Lax. Letter in *Phys. Rev.*, **78**, 306–7 (*May* 1, 1950).

A simple proof of the theorem that in a scattering problem the imaginary part of the forward scattered amplitude is proportional to the total collision cross-section is given with sufficient generality to include inelastic as well as elastic scattering, the creation and destruction of particles, spin-dependent, non-central and non-conservative forces.

W. J. SWIATECKI

539.152.1

6681. Nuclear mass determinations from nuclear *Q*-values. A. Tollestrup, W. A. Fowler and C. C. Lauritsen. *Phys. Rev.*, **78**, 372–4 (*May* 15, 1950).

Consistent values of the masses of the light nuclei have been calculated from the best measurements of *Q*-values for several nuclear reactions, and from mass spectrographic measurements. Tables are given of the *Q*-values and of the calculated mass values. A.

539.152.1 : 539.16 : 539.17

6682. Introduction to nuclear physics [Einführung in die Kernphysik]. Fourth, enlarged, edition. W. Riezler. *Berlin and Buxtehude. Herman Hübener Verlag* (1950) 309 *pp.* 8 *pl.* 119 *figs.* 8 *tables. In German.*

A comprehensive textbook on a descriptive and experimental basis, without advanced theoret mathematics. Chapter headings: Nuclear phy as a field of knowledge; Properties of the ato nucleus; Radioactivity; Nuclear reactions; Struc of nuclei; Methods of nuclear investigation; Ap cations of nuclear physics Tables: The eleme Physical and chemical atomic weights; Stable naturally occurring radioactive isotopes; Nuc moments of artificially radioactive nuclei; Natur occurring radioactive nuclei; Artificially radioac nuclei; Nuclear transmutations of the lighter elem by charged and uncharged particles; Chart of nuc species, Autumn 1948.

539.152.1 : 539.

6683. β-decay and the nuclear shell model. L. Nordheim. Letter in *Phys. Rev.*, **78**, 294 (*May* 1950).

A preliminary note on the application of the s orbit coupling scheme which leads to an unc standing of the allowed or forbidden character β-decays. Nuclei with odd mass number have simplest interpretation. The even mass numb nuclei must be divided into the two groups eve even and odd-odd, because of the coupling betw the proton and neutron groups in the latter, bef analysis. J. HUG

539.15

6684. The h.f.s. anomaly of the potassium isotop S. A. Ochs, R. A. Logan and P. Kusch. Letter *Phys. Rev.*, **78**, 184 (*April* 15, 1950).

The h.f s. spectra of both K^{39} and K^{41} were observ at a magnetic field of about 12 000 gauss. As $J = \frac{3}{2}$ the transitions $\Delta m_I = \pm 1$, $\Delta m_J = 0$ produ doublets. The doublet separations were 4·8 M for K^{39} and 2·6 Mc/s for K^{41}; the mean frequenc respectively 115 and 63 Mc/s, the line widths abo 2 kc/s. From measurements of the frequencies s the components of each of 2 doublets for each isotop and by the use of previous results for $g_I(K^{39})/g_J(^2S_{\frac{1}{2}})$ the following results were obtained: $(g_I{}^{39}/g_I{}^{41})$ $1{\cdot}8218 \pm 0{\cdot}0002$; $(\Delta\nu^{39}/\Delta\nu^{41}) = 1{\cdot}81768 \pm 0{\cdot}0000$ The last result $<$ the calculated value by 0·226 0·010%, and tends to support the single-partic model of the nucleus. L. PINCHER

539.152

6685. A table of nuclear moments, January 195 J. E. Mack. *Rev. Mod. Phys.*, **22**, 64–76 (*Jan.*, 195

The table includes nuclear spin, magnetic dipo moment and electric quadrupole moment. A br discussion and bibliography are given. J. HUGH

539.152

6686. Preliminary results on the spin of U^2 G. L. Stukenbroeker and J. R. McNally. Lett in *J. Opt. Soc. Amer.*, **40**, 336 (*May*, 1950).

Hyperfine structure studies are made on lines the U^+ spectrum using a Fabry–Perot interferomet and employing material enriched in U^{235}. A sp of 5/2 fits the observations best. Hyperfine splitti is inverted and occurs mainly in the $f^3ds(^6L_{11/2})$ lev Anomalies can be explained in terms of a quadrupo moment. S. TOLANS

539.152

6687. On the magnetic moments of Xe^{129}, Bi^2 Sc^{45}, Sb^{121}, and Sb^{123}. W. G. Proctor and F. C. Y Letter in *Phys. Rev.*, **78**, 471 (*May* 15, 1950).

539.152.2

. The nuclear magnetic moment of niobium93. ...FF, W. H. CHAMBERS AND D. WILLIAMS. ...er in *Phys. Rev.*, **78**, 476–7 (*May* 15, 1900).

539.152.2

. The nuclear magnetic moment of praseo-...ium141. W. H. CHAMBERS, R. E. SHERIFF AND ... WILLIAMS. Letter in *Phys. Rev.*, **78**, 482–3 ...y 15, 1950).

539.152.2: 621.317.311

). The use of nuclear magnetic resonance for ... determination of large electric currents. G. J. ...É, P. M. DENIS AND R. C. EXTERMANN. *Arch.* ..., **3** (*No.* 1) 49–51 (1950) *In French.*

...ince gyromagnetic ratios and resonance frequencies ... be measured accurately, it is possible to determine ... magnetic field produced by coils and hence the ...e of the exciting current. A quartz oscillator ... been used in conjunction with water to which ...amagnetic salts were added. With a current of ... A traversing the coils, it was possible to detect ...nges of the order of 1 mA. Currents can be ...pared by using a harmonic generator and absolute ...asurements obtained by relating the current to ... field produced, either from geometrical con...erations or by potentiometric methods.

G. F. HODSMAN (R)

539.153.4 : 535.342

)1. The quantal theory of continuous absorption ... radiation by various atoms in their ground states. ... Further calculations on oxygen, nitrogen and ...bon. D. R. BATES AND M. J. SEATON. *Mon. ...t. Roy. Astr. Soc.*, **109** (*No.* 6) 698–704 (1949).

...Exchange wave functions and both the dipole ...ment and dipole velocity formulae are used. At ... spectral heads the absorption cross-sections, in ... its 10^{-18} cm², are as follows: *O*, 2·6; *N*, 9; *C*, 11.

539.154.2 : 546

)2. Element 98. S. G. THOMPSON, K. STREET, ..., A. GHIORSO AND G. T. SEABORG. Letter in ...*ys. Rev.*, **78**, 298–9 (*May* 1, 1950).

...This has been prepared by the bombardment of ...n^{242} with 35 MeV α-particles. It has ½-life ~ 45 min, ...nits 7·1 MeV α-particles and is thought to have ...ass 244. The chemical separation and identification ...re made using ion exchange adsorption techniques. ...e name californium is suggested. B. ROSE

539.155

.93. Some new mass comparisons involving Si, Fe, ..., Cu, Zn, W, and Pt. H. E. DUCKWORTH, H. A. ...HNSON, R. S. PRESTON AND R. F. WOODCOCK. ...*ys. Rev.*, **78**, 386–90 (*May* 15, 1950).

A number of mass comparisons have been made ...ing a large Dempster-type mass spectrograph with a ...ark source. Packing fraction differences have been ...tained for the doublets Si^{28}–Fe^{56}, Si^{29}–Ni^{58}, Si^{30}–...i^{60}, W^{183}–Ni^{61}, W^{186}–Ni^{62}, Pt^{192}–Zn^{64}, Pt^{195}–Cu^{65}, ...^{198}–Zn^{66}. A.

539.155

;94. Masses of Pd^{104}, Pd^{108}, Pt^{195}, and Cu^{65} [by ...ass spectra]. H. E. DUCKWORTH, K. S. WOODCOCK, ...ND R. S. PRESTON. Letter in *Phys. Rev.*, **78**, 479–80 ...*May* 15, 1950).

539.155.2

6695. Introduction of measured liquid samples into the mass spectrometer. C. E. WISE, R. M. REESE, V. H. DIBELER AND F. L. MOHLER. *J. Res. Nat. Bur. Stand., Wash.*, **44**, 215–20 (*March*, 1950).

539.155.2

6696. Natural abundance of ^{13}C and ^{18}O and the isotope displacement in the solution equilibrium hydrocyanic acid/acetic acid. E. W. BECKER AND W. VOGELL. *Z. Naturforsch.*, **5a**, 174–5 (*March*, 1950) *In German.*

The mass-spectrogram of highly purified CO_2 obtained from CO from hydrocyanic acid has been investigated. The ratio of abundance of molecules of mass 45 to those of mass 44 is $0{\cdot}01216_6 \pm 0{\cdot}00002$, and that of mass 45 to mass 46 is $2{\cdot}393 \pm 0{\cdot}011$. Assuming an abundance of 0·078% for the molecule $C^{13}O^{16}O^{17}$ the natural abundance of C^{13} is $1{\cdot}12 \pm 0{\cdot}005$% and of O^{18} is $0{\cdot}205 \pm 0{\cdot}003$%. The isotope displacement in the equilibrium HCN (gas)/HCN (dissolved in acetic acid) has been investigated. This method avoids complications introduced by polymerization. The ratio of CO_2 molecules of mass 45 to those of mass 44 from the HCN in solution is $0{\cdot}01228 \pm 0{\cdot}00004$, and that of molecules of mass 45 to those of mass 46 is $2{\cdot}969 \pm 0{\cdot}009$. A. J. MEE

539.155.2

6697. Comparison of the isotopic constitution of terrestrial and meteoritic sulfur. J. MACNAMARA AND H. G. THODE. Letter in *Phys. Rev.*, **78**, 307–8 (*May* 1, 1950).

RADIOACTIVITY . α-, β- and γ-rays 539.16

539.16

6698. The new radioisotope laboratory of the University of North Carolina. H. D. BRUNER, A. ROE AND F. T. ROGERS, JR. *Amer. J. Phys.*, **18**, 264–8 (*May*, 1950).

539.16

6699. Radioactivity in hafnium. J. M. CORK, A. E. STODDARD, W. C. RUTLEDGE, C. E. BRANYAN AND J. M. LEBLANC. Letter in *Phys. Rev.*, **78**, 299 (*May* 1, 1950).

539.16

6700. The natural activity of lanthanum. R. W. PRINGLE, S. STANDIL AND K. I. ROULSTON. Letter in *Phys. Rev.*, **78**, 303–4 (*May* 1, 1950).

539.16 : 551.59

On the natural radioactivity of the atmosphere. *See Abstr.* 6907

539.16.08

6701. Monitor for radioactive dust. J. B. H. KUPER, E. H. FOSTER AND W. BERNSTEIN. *Nucleonics*, **6**, 44–7 (*April*, 1950).

For the measurement of airborne activity the active dust is collected on a band of filter paper which is moved continuously over an aperture through which air is drawn by a vacuum pump. The moving band passes an end mica window β-γ-counter and a ZnS scintillation α-counter. A hollow capstan drives the band at the rate of 1 in/hr from a drum

which holds about 6 months' supply. The capstan is perforated by small holes and pivots on a hollow sleeve which connects to the pump. Thus the air stream is drawn through the holes in the capstan and through a rectangular aperture in the sleeve. The slight suction of the paper into the capstan holes furnishes a positive drive. The β-counter records the activity of dust collected 1 hr before and the α-counter records that collected 4 hr earlier. Records obtained with this equipment indicated a sharp rise in airborne activity during inversion conditions.

L. R. SHEPHERD

539.162

6702. On the disintegration scheme of I^{131}. J. FEISTER AND L. F. CURTISS. Letter in *Phys. Rev.*, **78**, 179–80 (*April* 15, 1950).

539.163

6703. Spectroscopy of some artificially radioactive nuclei. A. C. G. MITCHELL. *Rev. Mod. Phys.*, **22**, 36–55 (*Jan.*, 1950).

A summary of available data on the disintegration schemes of 60 radioactive isotopes. Energy level diagrams are reproduced and angular momenta associated with the levels, types of β or γ transition involved and other important data are given when these are known.

L. R. SHEPHERD

539.163

6704. On the isomerism of Kr^{83}. I. BERGSTRÖM, S. THULIN AND G. ANDERSSON. Letter in *Phys. Rev.*, **77**, 851–2 (*March* 15, 1950).

Carrier-free Kr^{83} was isolated from other gaseous U-fission products in an e.m. separator. The active ions were collected on 0·15 mg/cm² Al foil which was penetrated to a depth $<$ 100 atomic layers, on account of the 30–60 keV energy of the ions. The samples were examined in 2 β-spectrometers and the electron spectrum was found to consist of K and L conversion lines due to a transition of energy $32{\cdot}7 \pm 0{\cdot}5$ keV. Values of 0·40, 0·39 and 0·44 were obtained in different observations for the ratio of K- to L-electron intensities. This ratio and the observed half-life ($6{\cdot}5 \times 10^3$ sec) are best fitted by a mixed transition $\sim 70\%$ electric 2^4 pole and $\sim 30\%$ magnetic 2^3 pole.

L. R. SHEPHERD

539.163

6705. Decay constants from coincidence experiments. T. D. NEWTON. Letter in *Phys. Rev.*, **78**, 490 (*May* 15, 1950).

539.163

6706. Measurement of a second half-life in Yb^{170}. R. E. BELL AND R. L. GRAHAM. Letter in *Phys. Rev.*, **78**, 490–1 (*May* 15, 1950).

539.163 : 539.155.2

6707. Investigations on the radioactive decay of the isotopes of technetium. H. MEDICUS, P. PREISWERK AND P. SCHERRER. *Helv. Phys. Acta*, **23** (*No.* 3) 299–346 (1950) *In German.*

The radioactive transformations of the Tc isotopes of masses 92, 94, 95 and 96 have been investigated using spectrometer, coincidence, absorption and cloud chamber methods. Complete decay schemes are given for these isotopes with the exception of Tc^{92}. Two isomers of Tc were also studied: that of Tc^{97} and a newly found one of unknown mass number, 51·5 min half-life and an excitation energy of 34·4 keV. The decay patterns of Tc^{93}, Mo^{99}–Tc^{99} and Mo^{101}–Tc^{101} are also recorded for comparison.

G. O. BAINES

539.163.1

6708. The half-life of Po^{208}. D. H. TEMPLETON. Letter in *Phys. Rev.*, **78**, 312 (*May* 1, 1950).

A careful determination, using two samples, yielded the figure of $2{\cdot}93 \pm 0{\cdot}03$ yr.

G. O. BAINES

539.163.2

6709. On the determination of the relative positron activity of Cu^{64} in a source of Cu^{61}. C. S. COOK AND C.-H. CHANG. Letter in *Phys. Rev.*, **78**, 171–2 (*April* 15, 1950).

539.163.2

6710. Disintegration scheme of In^{116}. H. SLÄTIS, S. J. DU TOIT AND K. SIEGBAHN. Letter in *Phys. Rev.*, **78**, 498 (*May* 15, 1950).

539.163.2 : 539.155.2

6711. Extension of alpha- and beta-decay systematics of protactinium isotopes. W. W. MEINKE AND G. T. SEABORG. Letter in *Phys. Rev.*, **78**, 475–6 (*May* 15, 1950).

539.163.2 : 539.164

6712. Fine structure of the magnetic alpha-particle spectrum of plutonium 239. S. ROSENBLUM, M. VALADARES AND B. GOLDSCHMIDT. *C.R. Acad. Sci., Paris*, **230**, 638–40 (*Feb.* 13, 1950) *In French.*

Photographic (track-count) recording was used, with exposures of 8–30 days in a permanent magnet spectrograph; the sources contained 1–10 μg Pu^{239}. Preliminary results show a main group, α_0, of energy 5·147 MeV (ThC = 6·089 MeV), and a second group, α_1, with $\sim$ 50 keV less energy and intensity $\sim \frac{1}{3}$ of α_0. Other less intense groups may also be present.

A. O. STANESBY

539.1632. : 539.165.2

6713. The internal conversion radiation of RdTh. G. ALBOUY AND J. TEILLAC. *C.R. Acad. Sci., Paris*, **230**, 945–7 (*March* 6, 1950) *In French.*

200 μ electron-sensitive nuclear emulsions (Ilford G5) were impregnated with RdTh and examined for α-particle and electron tracks. 1 850 α-particle tracks were obtained, and $\sim 7{\cdot}6\%$ of these had associated electron tracks, in agreement with Surugue and Tsien [*C.R. Acad. Sci., Paris*, **213**, 172 (1941)].

A. O. STANESBY

539.163.2 : 539.165.2

6714. Intense conversion radiation of U_{II}. J. TEILLAC. *C.R. Acad. Sci., Paris*, **230**, 1056–8 (*March* 13, 1950) *In French.*

Tracks in 200 μ electron-sensitive nuclear emulsions (Ilford G5) were examined 3–5 days after impregnation of the plates with uranium nitrate. Of 1 044 tracks due to U_{II} α-particles, 369 were accompanied by electron tracks, whose distribution in energy showed maxima at 36 and 50 keV. They may be produced by the (complete) conversion of a 55 keV γ-ray in the L and M shells; U_{II} must then show at least one intense fine structure line in its α-particle spectrum.

A. O. STANESBY

539.165

6715. Relative selection rules for forbidden β-transitions. II. R. NATAF. *C.R. Acad. Sci., Paris*, **230**, 737–9 (*Feb.* 20, 1950) *In French.*

Addition to previous note [Abstr. 5229 (1950)].

539.165 : 539.152.1

Beta-decay and the nuclear shell model. *See Abstr.* 6683

539.165 : 539.166

6716. On the β- and γ-radiation of actinium and actinium K. M. LECOIN, M. PEREY, M. RIOU AND F. TEILLAC. *J. Phys. Radium*, **11**, 227–34 (*May*, 1950) *In French.*

γ-radiation (Xe-filled G.M. counter): Ac: 37 keV (2·2/1 000 disintegrations); 15 keV (5·5/100) *L*-radiation from the internal conversion of the 37 keV γ-ray; 300 keV (2/1 000)—doubtful. AcK: 350 keV (6/100 disintegrations); 48·6 keV (27/100); *L*-radiation (25/100). β-radiation of Ac (low-pressure Wilson chamber) corresponding to conversion electrons of 37 keV γ-ray in *L* and *M* shells (15/100 dis.). An expected β-spectrum with $E_{max} < 37$ keV was not found. A. O. STANESBY

539.165.08

6717. RaDEF standard sources for beta-disintegration rate determinations. T. B. NOVEY. *Rev. Sci. Instrum.*, **21**, 280–5 (*April*, 1950).

The preparation and use of calibrated RaDEF equilibrium sources for absolute β-counting is described. The sources are essentially weightless and are mounted on a thin backing to reduce self-absorption and backscattering correction problems. Calibration was done by determination of the α-disintegration rate of RaF in a parallel plate α-ionization chamber. No secondary standards are required and the sources can be recalibrated at any time. As an example of the application of such standards, details of the calibration of a P^{32} solution distributed by the Bureau of Standards for intercalibration in February, 1949, are given. The final result is 88·8 mrd/ml at 8 a.m. C.D.T. March 1, 1949. The precision of the measurement is 0·3%. The accuracy is estimated to be 1–2%. A.

539.165.08 : 537.56

6718. Estimation of beta-activities from Bremsstrahlung measurements in an ionization chamber. P. C. TOMPKINS, L. WISH AND W. T. BURNETT, JR. *Analyt. Chem.*, **22**, 672–6 (*May*, 1950).

The radioactivity of a beta-emitting nuclide can be determined by using an ion chamber to measure the Bremsstrahlung radiation originating in the source and its container, The method is particularly applicable to the measurement of high intensity irradiation sources. The advantages of the method are: (1) ionization chambers have a much wider range. stability and linearity of response than conventional Geiger–Müller instruments; (2) the activity may be quantitated in solutions or solids, particularly those which are highly hydrated, without the necessity of chemical processing; and (3) the comparison with beta-activities as measured in the usual way provides an additional criterion of radioactive purity. The major limitations are: (1) an extreme sensitivity to the presence of a gamma-emitting impurity; (2) the relatively high activities required; and (3) variations arising from an inhomogeneous composition of the source and its immediate environs. A.

539.165.2

6719. Numerical evaluation of the Fermi beta-distribution function. I. FEISTER. *Phys. Rev.*, **78**, 375–7 (*May* 15, 1950).

In making a Fermi–Kurie plot of a β-spectrum various approximations have been used to evaluate $f(Z, \eta)$. It is probable, however, that none of these approximations is completely adequate for all values of Z and η. Hence an accurate computation and tabulation of this important function is now in preparation. Three approximations for $f(Z, \eta)$ are compared with some representative values of $f(Z, \eta)$ that have been computed for the proposed table, and the accuracy and range of validity of these approximations are indicated. A.

539.166

6720. On the theory of multipole radiation. M. FIERZ. *Helv. Phys. Acta*, **22** (*No.* 4) 489–500 (1949) *In German.*

Consideration of the classical and quantum mechanical forms of multipole radiations, and the use of the Clebsch–Gordan relations, permit a calculation of the correlations of direction and polarization for successive γ-radiations. A similar result is obtained if one of the photons undergoes *K*-conversion. J. R. MADDOX

539.166

6721. Study of the γ-rays of $^{99}_{42}$Mo in equilibrium with $^{99}_{43}$Tc. N. MARTY. *C.R. Acad. Sci., Paris*, **230**, 1270–2 (*March* 27, 1950) *In French.*

Mo^{99} obtained from fission products was examined with a semicircular focusing spectrometer provided with 2 counters in coincidence as detector. Both Compton and photo-electrons produced in various radiators were measured. γ-rays of 138 ± 1 keV, 740 ± 2 keV, 782 ± 6 keV and 845 ± 10 keV, the last two being markedly less intense, are emitted. J. HUGHES

539.166

6722. Internal conversion coefficients for Co^{60}. M. A. WAGGONER, M. L. MOON AND A. ROBERTS. Letter in *Phys. Rev.*, **78**, 295 (*May* 1, 1950).

539.166

6723. Gamma-rays from terbium 160. J. M. CORK, C. E. BRANYAN, W. C. RUTLEDGE, A. E. STODDARD AND J. M. LEBLANC. Letter in *Phys. Rev.*, **78**, 304 (*May* 1, 1950).

539.166 : 537.542

The scintillation counter as a low resolution gamma-ray spectrometer. *See Abstr.* 6580

539.166.08

6724. A photo-multiplier gamma-ray detector. J. D. GRAVES AND G. E. KOCH. *Rev. Sci. Instrum.*, **21**, 304–7 (*April*, 1950).

The sensitivity of the RCA 1P21 photo-multiplier to γ-radiation has led to the investigation of the characteristics of this tube as a γ-ray detector. The range, linearity, directional dependence, temperature dependence, applied voltage regulation requirements

and radiation energy dependence were determined for several tubes. Preliminary results concerning the ability of the tube to maintain a calibration are given. A basic circuit for such a detector is given. A.

539.166.08

6725. A monitor for low intensity gamma-rays. J. B. H. KUPER AND R. L. CHASE. *Rev. Sci. Instrum.*, **21**, 356–65 (*April*, 1950).

A recording monitor for low intensity gamma-radiation has been developed, using a simple and inexpensive form of dynamic condenser electrometer in connection with an ionization chamber and a commercial recording potentiometer. Use of a rate-of-drift method at relatively low voltage sensitivity eliminates difficulties with contact potentials and grounding key kicks. The instrument gives an indication and recycles when 5 μr have been received. Normal gamma-background current is 4 to 5×10^{-15} A and at this sensitivity the instrument is extremely rugged and operates outdoors in all weather. A.

539.166.08 : 537.542

6726. Gamma-ray radiation monitor. L. REIFFEL. *Electronics*, **23**, 107–9 (*May*, 1950).

A scintillation counter, covering the range 1 milliroentgen/hr to 100 roentgen/hr, 10^5 to 1, with an accuracy of within 15%, is described. The detector is an anthracene crystal and a type 931A photomultiplier tube selected for low absolute dark current, $\sim 10^{-9}$ A, and fed from a stabilized 900 V supply. This tube drives an R.C. low-pass filter, provided for smoothing out the pulse components, and this in turn is connected, along with a d.c. comparison voltage, to a vibrator-type 1-pole, 2-throw switch. Each voltage is sampled in turn and passed through an amplifier of 120 db gain to a power stage driving a servo motor. The motor drives the pointer of the indicating instrument and the slider of a special potentiometer capable of covering a voltage output range of 10^5 to 1 to provide the d.c. comparison voltage fed back to the switch. Performance limitations are set by dark-current variations at low levels and photomultiplier fatigue at high. Higher sensitivity and accuracy can be achieved by thermostatic control and pulse-height discrimination at the photomultiplier output. H. G. M. SPRATT

539.166.08 : 537.542 : 615.84

6727. Automatic isodose recorder with scintillation counter as gamma-ray detector. G. J. HINE, M. BERMAN AND M. M. ELKIND. *Rev. Sci. Instrum.*, **21**, 362–5 (*April*, 1950).

This paper describes an instrument for investigating the radiation field of any type of γ-ray source. A small $CaWO_4$ crystal together with a light-conducting quartz rod and a 1P21 photo-multiplier tube is used as γ-ray detector. The lines of constant radiation intensity in a selected plane (isodose curves) are recorded automatically with a good accuracy in a short period of time. A.

539.166.2 : 539.172.4

6728. Transitions to the ground states in nuclei excited by slow neutron capture. B. B. KINSEY, G. A. BARTHOLOMEW AND W. H. WALKER. Letter in *Phys. Rev.*, **78**, 481–2 (*May* 15, 1950).

NUCLEAR REACTIONS 539.17

539.17 : 539

6729. Nuclear reactions produced by slow negati π-mesons. M. G. K. MENON, H. MUIRHEAD A O. ROCHAT. *Phil. Mag.*, **41**, 583–618 (*June*, 1950).

Reactions produced by the nuclear capture of sl negative π-mesons have been studied by the phot graphic method. The disintegrations of the light a heavy elements of the emulsion have been d tinguished by methods which are described in deta Because of the large number of "stars" observed more than 2 500—it has been possible to make statistical approach to the study of the disintegration The general features of the "stars" produced by t disintegration of heavy nuclei are in satisfactc agreement with the predictions of the evaporati theory. In addition, the emission of fast, sing charged particles has been observed, most of whi must be attributed to an alternative process to that evaporation. Preliminary results have been obtain for the frequency of emission and the energy "spe trum" of these particles. The conclusion is reach that in the initial process of capture—the so-call "primary" process—the energy corresponding to t rest-mass of the π^--meson is shared among a larg number of nucleons than has commonly been assum hitherto. Observations on "stars" produced by th disintegration of light nuclei indicate that there is wide variety in the characteristics of the disintegratio which appear to be strongly dependent on the mann in which the primary distribution of energy tak place. A detailed analysis has been made of some the disintegrations due to C^{12} and N^{14} nuclei, l applying the conservation laws of mass energy an momentum. In the majority of cases, the prima interaction results in the production of one or tv fast neutrons and an excited residual nucleus whic then disintegrates. In a few cases, however, th primary interaction involves the nucleus as a whol resulting in its total disruption and the ejection fast α-particles.

539.172

6730. Note on high energy induced fission of B Y. YAMAGUCHI. Letter in *Progr. Theor. Phys.*, 143–4 (*Jan.–Feb.*, 1950).

It is stated that the scheme Bi^{209} (190 MeV $12n)Po^{199*}$ with subsequent fission of Po^{199*} whic had to be assumed by Goeckermann and Perlman c empirical evidence [Abstr. 485 (1950)] can be explaine by comparing the width for the emission of a nuclec with the fission width in each step of the evaporatior the latter becomes larger than the former after th emission of about 12 nucleons. W. J. SWIATECI

539.172

6731. On the binary and ternary photofission thorium 232. E. W. TITTERTON AND T. A. BRINKLE *Phil. Mag.*, **41**, 500–3 (*May*, 1950).

Photographic plates loaded with $Th(NO_3)_4 4H_2$ were irradiated with 24 MeV synchrotron γ-ray A fission density of $2{\cdot}5 \times 10^4$ per cm^3 was observed fc a 150 *R* irradiation. An examination of some 2 50 photofissions revealed 5 cases of ternary fission i which the 3rd particle was identified as a long-rang

-particle, ranging in energy from 11·2 to 18·0 MeV. even cases were also observed in which a 3rd short-ange particle was emitted. The distribution of ranges f the recoiling fission fragments in the photofission f Th^{232} were compared with those in the slow neutron ission of U^{235} and it is deduced that the former is ccompanied by the release of 0·82 of the energy of he latter. L. R. SHEPHERD

539.172.4

6732. Energy distribution of fission fragments from U^{235} and U^{233}. D. C. BRUNTON AND G. C. HANNA. *Canad. J. Res., A*, **28**, 190–227 (*March*, 1950).

A coincident pulse technique has been used which measures simultaneously the energies of both fragments of a fission pair. Previous work in this field was limited in statistical accuracy owing to low fission rates. With the Chalk River high flux pile and a 20-channel pulse analyser a rapid accumulation of data is made possible. The improved statistical accuracy has led to new results on the detailed dissociation of fragment pairs and on the energy variation occurring in each fission mode. A careful comparison of U^{233} and U^{235} has been made. A.

539.172.4

6733. Nuclear reactors in scientific experiments. J. D. COCKCROFT. *Endeavour*, **9**, 55–63 (*April*, 1950).

A short account of experiments made with neutrons from uranium fission reactors. 13 refs.

539.172.4 : 539.163.1

6734. Carrier-free manganese-54 from the pile? T. ALPER AND L. DU PREEZ. Letter in *Nature, Lond.*, **165**, 689–90 (*April* 29, 1950).

Pile-irradiated Fe was found to contain (in addition to Fe^{59}) an activity which was identified as 310-day Mn^{54} obtained by the reaction $Fe^{54}(n, p)Mn^{54}$. About 180 μc of this activity was present in 3 mc of Fe^{59}, indicating that the $Fe^{54}(n, p)$ reaction has a fairly high cross-section. L. R. SHEPHERD

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

6735. Detection of the π-μ-decay with a scintillation crystal. W. L. KRAUSHAAR, J. E. THOMAS, JR. AND V. P. HENRI. Letter in *Phys. Rev.*, **78**, 486–7 (*May* 15, 1950).

539.18

6736. Preliminary results on the production of mesons by photons on carbon and hydrogen. J. STEINBERGER AND A. S. BISHOP. Letter in *Phys. Rev.*, 494–5 (*May* 15, 1950).

539.18

6737. Production cross sections for π^+ and π^- mesons by 345-Mev protons on carbon at 90° to the beam. C. RICHMAN AND H. A. WILCOX. Letter in *Phys. Rev.*, **78**, 496 (*May* 15, 1950).

539.18

6738. Masses of the π- and μ-mesons. I. M. FREEMAN. Letter in *Nature, Lond.*, **165**, 933 (*June* 10, 1950).

Starting from the known values of the masses, an equation is developed from which they may be deduced. E. P. GEORGE

539.18 : 530.145

6739. The positive-negative ratio for π-mesons produced singly in collisions of nucleons with complex nuclei. G. F. CHEW AND J. L. STEINBERGER. Letter in *Phys. Rev.*, **78**, 497 (*May* 15, 1950).

539.18 : 537.591

Note on varitrons. *See Abstr.* 6596

539.18 : 537.591.1

6740. Considerations on τ-mesons. L. LEPRINCE-RINGUET AND C. PEYROU. *J. Phys. Radium.*, **11**, 243–6 (*May*, 1950) *In French.*

The properties of the τ-meson indicated by the more reliable isolated observations is reviewed. Systematic observations by various methods have all yielded a negative result. [The work of Alikhanyan *et al.* is not included.] Possible reasons for this negative result are discussed. E. P. GEORGE

539.181 : 539.185.9

6741. Direct measurements of the velocity of slow atomic particles. W. BRAUNBEK. *Phys. Bl.* (*No.* 4) 160–5 (1950) *In German.*

Reviews methods of measuring velocities, especially by time-of-flight observations, of particles in beams, principally for molecular and neutron beams.

J. D. CRAGGS

539.185

6742. Determination of the diffusion length and second spatial moment of thermal neutrons in water with a small boron chamber. K-E. LARSSON. *Ark. Fys.*, **2**, *Paper* 7, 47–59 (1950).

A Ra–Be source, fixed at the centre of a 9 cm radius hollow Al sphere was immersed in a large tank of water and the thermal neutron density, measured at various distances from the source by means of a small BF_3 chamber. The hollow sphere was filled either with pure water or with $CdSO_4$ solution, the difference in neutron densities measured in the two cases giving the density of neutrons which were already thermal on leaving the sphere. The diffusion length L is determined from the expression $r\rho \propto e^{-r/L}$, where ρ is the neutron density at distance r from the source. A value of $3{\cdot}25 \pm 0{\cdot}13$ cm was obtained for L after taking into account errors due to the absorption of epithermal neutrons in the $CdSO_4$ and due to the shadowing effect of the $CdSO_4$ on neutrons slowed down outside the sphere. The second spatial moment of Ra–Be neutrons in water, was also determined and a value of 366 cm^2 obtained.

L. R. SHEPHERD

539.185

6743. Scattering of 90 MeV neutrons by α-particles. Discussion. J. HEIDMANN. *C.R. Acad. Sci., Paris*, **230**, 831–2 (*Feb.* 27, 1950) *In French.*

The cross-section has been derived from the measurements with C^{12} and O^{16} assuming that these nuclei were made up of 3 and 4 α-particles respectively. After correcting for multiple scattering due to the pairs of α-particles in the O and C nuclei, for the interactions between the α-particles, and for the fact that the α-particle model is not the only possibility, a value of $\sigma_\alpha = (1{\cdot}74 \pm 0{\cdot}17) \times 10^{-25}$ cms^2, was obtained. The value obtained by extrapolating the

measured cross-sections for H, H^2, Li, Be, etc., was $\sigma_\alpha = 1{\cdot}90 \times 10^{-25}$ cms^2. The cross-section for the creation of fast deuterons and the amount of inelastic scattering were also calculated. J. HUGHES

539.185

6744. Resonance and thermal neutron scattering in V^{51}. M. HAMERMESH AND C. O. MUELHAUSE. Letter in *Phys. Rev.*, **78**, 175 (*April* 15, 1950).

The experimental values of the resonance and thermal neutron cross-sections are analysed in terms of the one-level Breit–Wigner formula. They are consistent with a level at 2 700 eV, with total angular momentum J = 30, $\sigma_{max} = 420$ b, and $\Gamma = 780$ eV. J. HUGHES

539.185

6745. Radioactive decay of the neutron. A. H. SNELL, F. PLEASONTON AND R. V. MCCORD. Letter in *Phys. Rev.*, **78**, 310–11 (*May* 1, 1950).

Positive results have been obtained with an apparatus designed to record electron-proton coincidences. The observations are consistent with neutrons in free flight transforming into protons, and electrons of max. energy less than 0·9 MeV. The half life has not yet been evaluated accurately but probably lies between 10 and 30 minutes. G. O. BAINES

539.185

6746. Radioactive decay of the neutron. J. M. ROBSON. Letter in *Phys. Rev.*, **78**, 311–12 (*May* 1, 1950).

Using a thin magnetic lens spectrometer and an electrostatic field the author has identified the positive particle from radioactive neutron decay as a proton. The number of protons collected has been estimated to give a value for the half life of the neutron lying between 9 and 25 mins. G. O. BAINES

539.185

6747. Determination of neutron densities by the permanganate method. J. ERBER, W. RIEDER AND E. BRODA. Letter in *Nature, Lond.*, **165**, 810 (*May* 20, 1950).

539.185 : 545.8

Neutron spectroscopy for chemical analysis. *See Abstr.* 6819

539.185.08

6748. A correction to be applied to the activity of neutron-activated cadmium-covered indium foils. J. W. KUNSTADTER. Letter in *Phys. Rev.*, **78**, 484 (*May* 15, 1950).

STRUCTURE OF SOLIDS 539.2

539.211 : 621.317.39 : 620.179.6

6749. On the determination of the roughness of metallic surfaces. C. WAGNER. *J. Electrochem. Soc.*, **97**, 71–4 (*March*, 1950).

It is shown that the polarization capacitance of an electrode can be measured readily with the aid of a ballistic galvanometer. This capacitance per unit apparent area can be considered to be approx. ∝ the roughness of the surface of the electrode. Results obtained on Ag electrodes illustrate the influence of pretreatment and ageing. A.

539.21

6750. Relation of the harmonic mean particle si to the specific surface of particulate matter. HERDAN. Letter in *Nature, Lond.*, **165**, 858–9 (*May* 2 1950).

539.21

6751. Behavior of granulated polymers und pressure. R. S. SPENCER, G. D. GILMORE AND R. WILEY. *J. Appl. Phys.*, **21**, 527–31 (*June*, 1950).

In such fabricating processes as extrusion an injection moulding it is frequently necessary to for a granular polymer through a channel. Friction forces between polymer and channel walls lead to drop in pressure through the granular materia Simultaneously, the applied pressure causes a con paction of the granules. Assuming that the granul mass has certain fluid-like properties, a simp theoretical expression for pressure transmission derived. Comparison with data on saran powde and granular polystyrenes shows good agreeme between theory and experiment. The effect lubrication is shown also. The compaction granular polystyrene follows the same pattern that observed in the earth's crust. The porosi decreases exponentially with increasing pressur The "compressibility coefficient" for the porosity granular polystyrene is comparable with that give for clays and shales.

539.23 : 537.533.7

6752. Studies on the surfaces of copper alloys b electron diffraction. H. TAZAKI AND H. HASHIMOTO *J. Sci., Hiroshima Univ.*, **14**, 44–7 (*July*, 1949).

The films formed on the surface of 4 different type of brass, by exposure in air, heating in a flam heating in an electric furnace and by acid corrosion are examined by electron diffraction. The types film formed and their rates of production are relate to the conditions of formation and the nature of th known impurities. J. THEWL

539.24 : 548.

6753. Inner structure of the solid state. C. A ZAPFFE. *Rev. Métall.*, **47**, 329–42 (*May*, 1950) *French.*

The microstructures of crystalline and poly crystalline solids, both metallic and non-metallic have been studied by the author's technique fractography, i.e. photo-micrographic examinatio at high magnifications and high intensity of illumina tion, of cleavage planes and fractured surface Photographs showing microstructures and defect of several types of solid are presented. C. A. HOGARTH

539.2

6754. Structure and physical properties of massiv nylon. G. L. CLARK, M. H. MUELLER AND L. L STOTT. *Industr. Engng Chem.*, **42**, 831–41 (*May* 1950).

Utilizing familiar metallurgical techniques (X-ra diffraction, photomicrography, hardness and density measurements, heat treatment and recrystallizatio in various liquid media, tensile measurements, etc.) studies have been made of the structure and texture of massive nylon ranging in size from 0·011-i strip to 3-in rod. Of principal interest is the fact tha

ne two most intense X-ray diffraction rings vary in ngular position depending upon the previous istory of the sample, such as size, cooling rate, eat treatment and ageing. It is possible directly to orrelate many of the properties of the nylon with nese angular shifts. A.

539.26 : 539.4.016.2

6755. The effect of cold-work distortion on X-ray atterns. B. E. Warren and B. L. Averbach. *. Appl. Phys.*, **21**, 595–8 (*June*, 1950).

With modern experimental technique it is possible o measure a peak shape with sufficient accuracy to ustify an interpretation based on the precise shape f the reflection. The corrected shape is represented y a cosine Fourier series and a set of A_n coefficients etermined. A plot of the A_n coefficients *v.* n will listinguish between distortion and particle size roadening. From the A_n coefficients, root mean quare values of strain averaged over lengths na_3 re obtained. The decrease in these values for ncreasing length na_3 is a direct indication of the on-uniform nature of the strains in cold-worked netal. By measuring several orders of a given lane, it is theoretically possible to obtain a distriution function of the strains directly from a Fourier ransform of the A_n coefficients. A.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.31 : 539.11 : 541.64

6756. Stress phenomena from the respective viewpoints of solid-state and high polymer physics. M. L. Huggins. *J. Appl. Phys.*, **21**, 518–19 (*June*, 1950).

Flow and elastic properties are considered, in a qualitative manner, for the following types of materials: crystalline solids, simple liquids, glasses and high polymers. A.

539.312

6757. Some theoretical considerations of dynamic-property data on textile specimens. W. J. Lyons. *J. Appl. Phys.*, **21**, 520–2 (*June*, 1950).

539.312

6758. Ultra speed tensile of rubber and synthetic elastomers. D. S. Villars. *J. Appl. Phys.*, **21**, 565–73 (*June*, 1950).

A high speed stress-strain machine has been developed which is capable of recording the stress-strain curve of elastomers at elongation rates up to 270%/msec. Data are reported and discussed. A.

539.312

6759. Measurement of the dynamic properties of rubber. L. Mullins. *Trans. Instn Rubb. Ind.*, **26**, 27–44 (*June*, 1950).

The limitations of the use of a simple mechanical model to describe the elastic behaviour of rubber and to assist in the interpretation of the results of dynamic forced vibration tests are discussed. A description is given of an apparatus which enables complete steady state hysteresis loops to be determined on rubber samples subjected to constant alternating deflection. Measurements made over a range of frequencies and temperatures confirm the inadequacies of the techniques usually employed in the interpretation of the results of forced vibration tests, and show that these results should only be used in problems where the rubber is required to operate under similar conditions to those employed in the test. An investigation into the reported large differences between the static modulus and the dynamic modulus measured at very low frequencies indicates that these differences are due to elastic after-effects of previous deformations, and that the dynamic stress-strain curve determined at low frequencies closely follows the course of the static stress-strain curve determined, over the same range of stress and strain, immediately after the dynamic test has been completed. A.

539.312

6760. Measurement of the dynamic properties of rubber. W. P. Fletcher and A. N. Gent. *Trans. Instn Rubb. Ind.*, **26**, 45–63 (*June*, 1950).

A description is given of an apparatus designed to provide data on the dynamic modulus and viscosity of bonded rubber test-pieces in shear over the frequency range 20–120 c/s and at amplitudes from approximately 0·01% to 5% shear strain, devices being incorporated to apply static shear and/or compressive strains to the specimens. Three stocks have been examined, a gum stock, a lamp-black loaded stock and a gas-black tyre tread type stock. The modulus is independent of frequency in the range examined, but the viscosity varies according to a law of the form $\eta \propto \nu^c$, c being $-0{\cdot}70$ to $-0{\cdot}95$ dependent on the type of compound employed. A decrease in modulus on increasing amplitude from 0 to 2½% shear strain of 5% for the gum stock, 11% for the lamp black stock, and 43% for the gas black stock was observed; similar decreases occur on the superimposition of static strains. The gas black stocks in particular are sensitive to previous history. There are also viscosity changes produced by these factors. A.

539.312

6761. Measurement of the dynamic elasticity of rubber. K. W. Hillier. *Trans. Instn Rubb. Ind.*, **26**, 64–77 (*June*, 1950).

A method of measuring the propagation and attenuation of longitudinal oscillations in filaments of rubber-like materials is briefly described, and measurements made at temperatures of 0°C to 40°C and at frequencies of oscillation between 0·5 kc/s and 4 kc/s are given. The materials used were natural rubber, gutta percha and the synthetic rubbers GR-S, perbunan and neoprene, all lightly vulcanized in the form of filaments. The method was used to measure the changes in the velocity of propagation and hence in the modulus when the filament was strained, and the results include such measurements with filaments extended to 300% of their original length. Ordinary tensile measurements have been carried out simultaneously and directly comparable values of the dynamic and "static" modulus obtained. A.

539.312

6762. Theoretical aspects of dynamical experiments on rubber. R. S. RIVLIN. *Trans. Instn Rubb. Ind.*, **26**, 78–85 (*June*, 1950).

The usual vibration equation employed for evaluating the dynamic elastic modulus and viscosity coefficient in dynamical experiments on rubber is discussed critically for the case when the elastic modulus and viscosity depend on the frequency and amplitude of vibration. A mathematical framework is constructed from which it can be seen how the frequency- and amplitude-dependences arise from a phenomenological point of view. A.

539.32

6763. The measurement of the coefficient of internal friction of solid rods by a resonance method. W. LETHERSICH AND H. PELZER. *Rep. Brit. Elect. Res. Ass.* (*Ref. L/T* 213) 7 *pp.* (1949).

A theory is given and an expression derived relating amplitude of vibration with frequency for a rod subjected to alternating mechanical stress. The coefficient of internal friction of the material can be deduced providing the internal friction is small, as for example with metals. With plastics the internal friction is larger, so that a correction must be applied which can be expressed in the form $\eta/E = (\delta f/2\pi f^2)(1 + 2\delta f/f)$. The physical basis from which the fundamental equations are derived is discussed and the relation between longitudinal and tangential viscosity is deduced. An expression has also been derived which enables the volume viscosity to be determined should experiments show the existence of volume viscosity. A.

539.32

6764. Mechanical properties of oriented polystyrene film. L. E. NIELSEN AND R. BUCHDAHL. *J. Appl. Phys.*, **21**, 488–93 (*June*, 1950).

Cast films of polystyrene were oriented by stretching at temperatures above the softening temperature of the material and then cooled. A factorially designed experiment was carried out in which the amount of stretching, temperature of stretching, time held in the stretched state before cooling, and effect of several cycles of stretching before cooling were investigated as they affect the birefringence, the stress-strain properties, dynamic modulus and damping, and the softening temperature of polystyrene. The values of many of the mechanical properties are more closely related to the birefringence than to the amount of hot stretching. In general, the value of the stress-strain properties in the direction of hot stretch, the dynamic modulus, and the birefringence all increase with an increase in the amount of stretching, a decrease in temperature, an increase in rate of cooling after stretching, and a decrease in the number of times the film was stretched before finally cooling. The softening temperature is decreased in direct proportion to the birefringence. Annealed films give higher softening temperatures than films which have been stretched and then allowed to shrink before cooling.

539.32 : 532.13

6765. Mechanical properties of substances of high molecular weight. VIII. Dispersion of dynamic rigidity and viscosity in concentrated polyvinyl acetate solutions. J. D. FERRY, W. M. SAWYER, G. BROWNING AND A. H. GROTH, JR. *J. Appl. Phys.*, 2 513–17 (*June*, 1950).

The dynamic rigidities and viscosities of co centrated solutions of polyvinyl acetate in 1, 2, trichloropropane have been obtained from transduc and wave propagation measurements. Two polym samples with number-average molecular weights 140 000 and 840 000 were studied in the lower audi frequency range at concentrations from 3 to 40 and temperatures from −3 to 41°C. For eac sample, when the reduced dynamic rigidity $G'T_0/$ and the reduced dynamic viscosity η'/η were plotte against the reduced frequency, $\omega\eta T_0/T_c$, all the da superposed to give two composite dispersion fun tions. The distribution of Maxwellian relaxati times can be derived from the dispersion of eith G' or η', and the two calculations are in reasonab agreement.

539.32 : 535.55 : 548

6766. The elastic and photoelastic constants of fus quartz. K. VEDAM. Letter in *Phys. Rev.*, **78**, 472 (*May* 15, 1950).

539.32 : 536.71 : 541.6

6767. Equation of state for high polymers. R. SPENCER AND G. D. GILMORE. *J. Appl. Phys.*, 2 523–6 (*June*, 1950).

Reports isothermal compression measurements o polymethyl methacrylate, polyethylene, cellulo acetate-butyrate, and ethyl cellulose at temperatur within the fabrication range. The equation of sta suggested earlier [Abstr. 5768 (1949)] is shown t apply equally well to these thermoplastics as t polystyrene and values are given for the constant The usefulness of this relationship is illustrated in brief discussion of some phases of the injectio moulding process. A

539.32 : 539.216.

6768. A non-destructive mechanical test for anima fibers. H. M. BURTE. *J. Appl. Phys.*, **21**, 494 (*June*, 1950).

539.32 : 539.216.1

6769. The new dynamical method for measurin Young's modulus and internal friction of fibers an films. H. KAWAI AND N. TOKITA. *J. Phys. Soc Japan*, **5**, 17–20 (*Jan.–Feb.*, 1950).

A horizontal Fe bar, fixed at one end and drive electromagnetically, vibrates transversely. At th point where one end of the short (about 1 cm) thin elastic and vertical specimen, *S*, is attached, the ba carries a small load *m*. A large load *M* is attache to the other end of *S*. By adjusting *m* so that th frequency of vibration of the rod is the same with o without *m*, *S* and *M*, Young's modulus, *E*, for *S* i determined. From a graph of the amplitude o vibration (measured with an electromagnetic pick-up against frequency the internal friction is determined The theory of the method, and the experimenta apparatus used, are fully described. Results fo Cu wire, raw silk fibre and paper samples are given S. WEINTROUB

539.373 : 548.0

'0. A new criterion for the occurrence of slip in n single crystals. T. L. Wu and R. Smoluchowski. *vs. Rev.*, **78**, 468–9 (*May* 15, 1950).

t has been found that in thin crystals of Al slip es not occur in the plane or direction which corre- nds to the maximum resolved shear. Instead, slip ections are favoured which correspond to a short h of slip across the crystal. A formula is derived ich permits one to predict the behaviour of thin gle crystals in tension. A.

539.374

71. Mechanical properties of polyethylene. R. H. REY, E. F. Schulz and G. J. Dienes. *Industr. gng Chem.*, **42**, 842–7 (*May*, 1950).

539.374 : 518.61

72. Relaxation methods applied to problems of stic flow. II. J. A. Jacobs. *Phil. Mag.*, **41**, 458–67 *fay*, 1950).

See Abstr. 5354 (1950). The problems are con- lered here: (i) a sharp-ended bar under specified ge tractions; (ii) the uniform compression of a block tween two smooth rigid plates, which do not erlap it. A.

539.374 : 534.2

73. The effect of thermal oscillations on plastic formation. G. Leibfried. *Z. Phys.*, **127** (*No.* 4) 4–56 (1950) *In German.*

By assuming an effective cross-sectional area equal the square of the lattice constant of the material, equation is obtained for the scatter of mechanical ves in the material and for the pressure thus nerated. The frictional effect of the wave is timated and an equation obtained for the friction the thermal oscillations within the mass. The essure due to the oscillation is related to the eoretical shear stress, and then a relationship is tained connecting the theoretical shear strength, e lattice constant and the melting point. The lation appears to be confirmed by the experimental lues obtained for Al, Pd, Cu, Ag, Au and Pb.

A. C. WHIFFIN

539.374 : 536.75

74. The thermodynamics of plastic deformation d generalized entropy. P. W. Bridgman. *Rev. Mod. ys.*, **22**, 56–63 (*Jan.*, 1950).

A method is suggested by which the concept of tropy can be generalized so as to apply to in- nsically irreversible processes, in which the final ate is not attainable from the initial state by an ternative reversible process. A plastic solid with a ess-strain hysteresis cycle is considered in detail. n expression is derived for the total irreversible tropy increase arising from an irreversible change a solid, in the case when the degree of internal sorder may be supposed specified by a single rameter α (in addition to the pressure and mperature). J. G. OLDROYD

539.374 : 537.226.3

75. Mechanical and electrical properties of asticized vinyl chloride compositions. L. E. Nielsen, . Buchdahl and R. Levreault. *J. Appl. Phys.*, , 607–14 (*June*, 1950).

The temperature-dependence of the dynamic mechanical and a.c. electrical properties of a given polyvinyl chloride plasticizer composition can be characterized by two quantities: (*a*) the transition temperature, which is defined as the temperature of maximum dissipation factor; and (*b*) the half-widths of the loss-factor/temperature curve. A simple relationship exists between the transition temperature determined mechanically or electrically and the volume fraction of a compatible plasticizer. The modification of this relationship for non-compatible plasticizer has been indicated. The half-width is a function of the volume fraction of the plasticizer, although this relationship is not as simple as the one obtained for the transition temperature. A simple correlation exists between the electrical and mechanical half-width. The compliance measured in tensile creep has been found to be a function of the applied load and the compliance/load relationship varies depending on the region in which the material finds itself. The shape of the creep curve at different temperatures has been correlated with the dissipation-factor/temperature curve. The shape of the stress-strain curve has been related to the modulus/temperature curve and a correlation between the initial Young's modulus and the ultimate elongation and breaking strength has been established. It has been shown that the relaxation theory is not sufficient to explain certain features of the modulus (or dissipation factor) temperature relationship. The limited significance of the μ-value and of the viscosity of plasticizers with respect to plasticizer efficiency has been demonstrated. A.

539.377

6776. The calculation of the activation energies of recovery and recrystallization from hardness measurements on copper. N. Thorley. *J. Inst. Met.*, **77**, 141–61 (*April*, 1950).

539.382

6777. Extension to the tri-axial stress-strain relation of solid materials. J. Majer. *Öst. Ingen. Arch.*, **4** (*No.* 2) 140–53 (1950) *In German.*

A well-known equation for tri-axial, non-linear stress-strain relation can be extended to so-called "brittle" materials. A plausible physical explanation for choosing the given form of equations is made possible by introducing the hypothesis of two deformation mechanisms and their limiting conditions. A.

539.383

6778. On the compressibility of metallic cesium. R. Sternheimer. *Phys. Rev.*, **78**, 235–43 (*May* 1, 1950).

The volume discontinuity of Cs at 45 000 kg/cm^2 is attributed to a shift of the valence electrons from the 6*s* zone to the empty 5*d* zones. A Wigner–Seitz calculation for the 6*s* and 5*d* bands supports this explanation. The potential used is described and tabulated. The possible existence of similar transitions for K and Rb is discussed. A.

539.4.016.2

6779. A quantized theory of strain hardening as applied to the cutting of metals. M. C. Shaw. *J. Appl. Phys.*, **21**, 599–606 (*June*, 1950).

A theory of strain hardening is presented which utilizes the fact that metals deform blockwise rather than continuously. A metal is assumed to possess

an orderly array of weak spots through which slip planes pass. The slip displacement which occurs upon a single plane is related to the spacing of weak points and the slip plane inclination. Use of a linear relation between shear plane displacement and resisting shear stress enables the mean shear stress to be computed. In the two examples considered it is seen that the influence of normal stress on the shear plane is less important in cutting than has been generally believed. Strain hardening and the short range inhomogeneity of metals is seen to account for most of the dynamic increase in shear strength during cutting, including the increase in shear energy per unit volume with decreased depth of cut. This size effect is akin to the increase in tensile strength with decreased specimen diameter, both phenomena involving strain hardening as influenced by inhomogeneity. A.

539.434

6780. Equivalent effects of time and temperature in the shear creep and recovery of elastomers. F. S. Conant, G. L. Hall and W. J. Lyons. *J. Appl. Phys.*, **21**, 499–504 (*June*, 1950).

An explicit relationship is set forth for the time-temperature dependence of the viscoelastic phenomena in the superelastic polymers. An empirical equation that was found to represent adequately the above-mentioned relationship over the entire multiple-temperature curve is of the form: $\log t_c = [C_\alpha/(T-b)] + C_\beta$. Experimental verification is given for the equivalent influence of time and temperature on the creep and recovery of compounds based on Hevea, GR-S, Neoprene GN, Butaprene, and butyl rubber. A comparison of the empirical equation with that of a theoretical reaction-r equation of Tobolsky and Eyring indicates temperature-dependence of the energy of activatio

539.

6781. Creep and the shear strength of grea G. V. Vinogradov and K. I. Klimov. *Dokl. Ak Nauk, SSSR*, **71** (*No.* 4) 697–701 (1950) *In Russian*

A study of the rheology of Ca-base greases at l rates of shear τ to demonstrate that, despite their l yield point at shear stress of small magnitude, grea have a limit of deformation and creep; also to rev the strength properties of greases using a tors elastometer in which torque is applied to a cylin immersed in the grease. Curves are plotted of deformation γ against time and of τ against γ. effects on the test performance of the grease of work it and allowing it to recover are discussed.

W. R. STOE

539

6782. Mayer analysis of metals. D. Hatch A E. J. W. Whittaker. Letter in *Nature, Lond.*, 1 646–7 (*April* 22, 1950).

Experimental evidence is advanced to show that hardness testing the law $L = ad^2$ is valid over a w range, using lead and steel balls. The precise fo of the variation of a with D is undetermined.

G. O. BAI

539.

6783. The effect of applied load in micro-indentat tests. W. Rostoker. *J. Inst. Met.*, **77**, 175 (*April*, 1950).

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.123.5

6784. Some aspects of isotopic exchange reactions. E. Rona. *Acta Phys. Austriaca*, **3** (*No.* 4) 418–21 (1950).—Brief review. 17 refs.

541.123.59

6785. Dissociation and exchange equilibria of the tritium halides. J. Bigeleisen. *J. Chem. Phys.*, **18**, 481–5 (*April*, 1950).

The ratios of the partition functions of the tritium halides to their respective protium halides have been calculated. These are combined with one another to give the exchange equilibria between the 6 pairs of tritium and protium halides. The exchange equilibria with water are calculated. From the exchange equilibria between the tritium halides and protium and the free energy of dissociation of the protium halides, the dissociation equilibria of the tritium halides have been calculated. The experimental data on the dissociation of HI are reviewed and it is shown that the data of Taylor and Crist on DI and HI are self-consistent as well as in good agreement with theory. The heat of formation of HI at absolute zero, ΔH_0^0, is found to be $-1\,007 \pm 10$ calories mole.

541.

6786. Quasi-unimolecular and quasi-bimolecu steps in complex reactions. The dissociation of nit gen pentoxide. R. A. Ogg, Jr. Letter in *J. Che Phys.*, **18**, 572–3 (*April*, 1950).

541.

6787. Gaseous detonations. I. Stationary waves hydrogen–oxygen mixtures. D. J. Berets, E. Greene and G. B. Kistiakowsky. *J. Amer. Che Soc.*, **72**, 1080–6 (*March*, 1950).

Detonation velocities in H–O mixtures with a without addition of A and He have been determi in tubes of two diameters over a wide range of co centrations. Comparison with velocities calcula by the Chapman–Jouguet theory shows agreem only for mixtures with a ratio of H to O not far fr stoichiometric. The deviations from the theory only partially explainable by losses of energy to walls of the tube. Evidence is presented to show t the internal heat capacity of polyatomic gases m not be fully excited and also that the chemical reacti may not reach the state of thermodynamic equilibri in the Chapman–Jouguet plane of some detonati waves.

541.126

6788. Gaseous detonations. II. Initiation by shock waves. D. J. BERETS, E. F. GREENE AND G. B. KISTIAKOWSKY. *J. Amer. Chem. Soc.*, **72**, 1086–91 (*March*, 1950).

Impact of plane shock waves on detonable gas mixtures causes the following pattern of phenomena with increasing strength of shocks: the weakest shocks are transmitted by such mixtures with slow decay, indistinguishable from decay in non-reactive gases; shocks whose peak temperature exceeds the ignition temperature of the gas mixture are propagated with a slowly rising velocity and when the initial shocks are more intense, this phase is followed by the development of a full detonation wave. Such delayed detonation waves are propagated initially with very high velocities which rapidly decay to the stationary values. The strongest shocks produce immediate detonation. A.

541.126

6789. Atomic oxygen in carbon-monoxide explosions. A. S. LEAH, C. ROUNTHWAITE AND D. BRADLEY. *Phil. Mag.*, **41**, 478–94 (*May*, 1950).

541.126 : 531.571

6790. Anomalous rates of burning in cordite. J. D. HUFFINGTON. *Nature, Lond.*, **165**, 840–1 (*May* 27, 1950).

When 2 plane parallel cordite surfaces separated by a narrow gap of the order of 0·5 mm are ignited, the rate of decomposition is not high enough to establish steady burning, although it is too fast to give rise to bulk-phase heating. Experiments are described from which it is concluded that under these conditions decomposition is intermittent, periods of quiescence alternating with periods of very rapid burning. During each rapid-burning phase the surface recedes by about 3 μ; this is possibly the distance between adjacent nitroglycerine globules. A black deposit of intermediate decomposition products accumulates on the cordite surface during the rapid-burning phase; it is suggested that examination of this black deposit may reveal structural details not readily identifiable in the unburnt material. Evidence has been obtained in this way for the existence of nitroglycerine particles about 1·8 μ dia. which cluster into colonies each 15 μ dia.

A. SCHOFIELD

541.127

6791. The effect on reaction rates caused by the substitution of C^{14} for C^{12}. W. H. STEVENS AND R. W. ATTREE. Letter in *J. Chem. Phys.*, **18**, 574 (*April*, 1950).

541.127.7

6792. Experimental evidence for the quasi-unimolecular dissociation of nitrogen pentoxide. R. A. OGG, JR., W. S. RICHARDSON AND M. K. WILSON. Letter in *J. Chem. Phys.*, **18**, 573 (*April*, 1950).

541.128

6793. The catalysis of the ortho-para conversion in liquid hydrogen. C. A. SWENSON. *J. Chem. Phys.*, **18**, 520–2 (*April*, 1950).

The catalysis of the ortho-para conversion in liquid H is of importance for the quantity production of pure parahydrogen. Parahydrogen is of interest in itself: however, from a purely practical standpoint, if liquid hydrogen were to be kept for any considerable length of time, it would be much more economical to store liquid parahydrogen than normal (25% para) liquid H. Rough determinations of the conversion constant, both in the adsorbed layer of the catalyst and in the actual liquid, are given for activated charcoal and for silica gel on to which oxygen gas had been adsorbed. The heat of mixing of ortho- and parahydrogen was also measured, and found to be smaller than the accuracy of measurement. A.

541.128

6794. Applications of reaction kinetics to metallographic problems. G.-M. SCHWAB AND G. PETROUTSOS. *J. Phys. Coll. Chem.*, **54**, 581–98 (*April*, 1950).

ELECTROCHEMISTRY 541.13

541.132

6795. On the tendency of the metal ions toward complex formation. J. BJERRUM. *Chem. Rev.*, **46**, 381–401 (*April*, 1950).

541.132.3 : 621.316.79.076.7

6796. Circuit and constructional details of the precision electronic pH control system. J. E. BREEZE. *Nat. Res. Coun. Can. Publ.* (*No.* 8189) (*Feb.*, 1949).

The system designed primarily to control *p*H of acid-producing bacteria in fermenting solutions by the addition of alkali, it controls to 0·01 *p*H over the range 1–12 *p*H, on 3 separate channels. Standard glass and calomel reference electrodes are used with pulsed millivoltmeters; the input voltages are switched mechanically at 30 per minute and compared with a reference potential so that the following amplifiers receive pulses of amplitude and sign depending on the algebraic difference between standard and electrode potentials. The final pulses are rectified to produce a d.c. output which is used to control the variable delivery reagent pumps via a differential relay. Recording milliammeters act as general purpose monitors, a c.r. indicator is used as a balance and pulse check and a standard cell and galvanometer are for adjustment of the reference potentials.

E. D. HART (R)

541.133

6797. The electrical conductivity of chlorine trifluoride, bromine trifluoride, and iodine pentafluoride. A. A. BANKS, H. J. EMELÉUS AND A. A. WOOLF. *J. Chem. Soc.*, 2861–5 (*Nov.*, 1949).

The specific conductivities are $< 10^{-6}$ (at 0°), $8{\cdot}0\times10^{-3}$ (at 25°) and $2\text{–}3\times10^{-5}$ (at 25°) $ohm^{-1}cm^{-1}$, respectively. That of BrF_3 decreases with temperature in the range 15–60°, but for IF_5 there is a positive temperature coefficient. Ohm's law is obeyed in the case of BrF_3 but not in that of IF_5. The existence of the ions BrF_2^+ and BrF_4^- in liquid BrF_3 is postulated to explain the observed phenomena. A.

541.133.1 : 532.72

6798. The use of radioactive isotopes in the study of the diffusion of ions in solution. J. S. ANDERSON AND K. SADDINGTON. *J. Chem. Soc.* (*Suppl. No.* 2) S381–6 (1949).

A method is described by which the "self-diffusion"

coefficient of an ion may be determined. It involves the preparation of two solutions which are identical except that in one of them the ion is "labelled" by means of a suitable radioactive tracer atom. A capillary cell is charged with the active solution and immersed in the inactive liquid for a known length of time so that normal diffusion can take place. The cell contents are then transferred to a suitable tray, evaporated to dryness, and the radioactive content measured in standard counting equipment. A reference tray is similarly prepared, a known volume of the active solution which has not undergone the diffusion process being used. The activity of this tray is measured immediately after that of the experimental tray, and from the values so obtained, that fraction of the original cell content which has passed out of it as a result of diffusion can be calculated. Knowing the length of the capillary cell and the time of diffusion, the self-diffusion coefficient of the ion may be calculated. Some results obtained on application of the method to the system of tungstic acids are described.

A.

541.133.1 : 532.72

6799. Self-diffusion coefficients of sodium ion and iodide ion in aqueous sodium iodide solutions. J. H. Wang and J. W. Kennedy. *J. Amer. Chem. Soc.*, **72**, 2080–3 (*May*, 1950).

A method for the determination of self-diffusion coefficients of ions in solution by means of isotopic tracers is described. The average error in this method is ± 1%. The self-diffusion coefficients of Na^+ and I^- in aqueous NaI solutions at concentrations from 10^{-4} to 3·5 M at 25·0° have been determined. The experimental values of the self-diffusion coefficients at infinite dilution are compared with the values predicted by the Nernst limiting equation.

A.

541.135 : 537.311

6800. Studies on the formations of barrier anodes of aluminium. K. Gumiński and Z. Seweryn. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*No.* 5–6) 91–9 (*May–June*, 1949).

Experiments are described on Al anodes formed in a solution of oxalic acid to a determined P.D. with a constant current; (*a*) curves for dependence of current intensity on voltage; (*b*) with an applied lower constant P.D., the reading of the current intensity during a period of time. The data indicate the formation of thick layers to be connected with their constant dissolution and re-formation, and so with a larger participation of ion conduction. In dilute solution, where the dissolution is small, the electron conduction plays the major role. The thick layers have a more amorphous and less coherent structure, while the thin layers are more crystalline.

H. H. HODGSON

541.135.5

6801. Anode effect in aqueous electrolysis. H. H. Kellogg. *J. Electrochem. Soc.*, **97**, 133–42 (*April*, 1950).

A phenomenon which closely resembles "anode effect" in molten electrolysis can be developed in the electrolysis of aqueous solutions at high current density. Normal operation of the electrode ceases and a so-called "transition period" begins when the electrode temperature reaches the boiling point of the electrolyte. When the applied voltage is increas beyond a critical value the transition behavic suddenly changes to the "aqueous anode-effec During this effect the surface temperature of t anode rises far above the boiling point of the electr lyte. Evidence is provided which indicates that t gaseous envelope surrounding the anode during t aqueous anode-effect is maintained by the vaporiz tion of the electrolyte against the hot anode surfac An aqueous cathode-effect was also obtained. T relation between aqueous anode-effect and ano effect in molten media is discussed.

PHOTOCHEMISTRY RADIATION CHEMISTRY 541.14

541.1

6802. Chemical identity of the sulphur formed by th slow neutron bombardment of alkali chloride U. Croatto and A. G. Maddock. *J. Chem. So* (*Suppl. No.* 2) *S*351–5 (1949).

The S produced by irradiation of KCl with slo neutrons is shown to be present in the crystal lattic as sulphate ion or as some highly reactive ion whic gives rise to sulphate in all aqueous solutions.

A

541.1

6803. Two factors affecting the use of the rotatin sector in photochemical experiments. W. G. Burn and F. S. Dainton. *Trans. Faraday Soc.*, **46**, 411–1 (*May*, 1950).

The theory of the use of the rotating sector in th study of photochemically-initiated, unbranched chai reactions has been extended to include non-uniform light intensity. The value of corrections to be applie in a particular case are deduced and tabulated an illustrate the application of the method. Th penumbra error, i.e. the error introduced by assumin that the light pulse is square, is discussed and it magnitude evaluated for a trapezoidal pulse. Th error is very small and only important at very lo sector speeds.

A

541.141

6804. The mercury photosensitized reactions o methyl alcohol. M. K. Phibbs and B. de B. Darwent *J. Chem. Phys.*, **18**, 495–8 (*April*, 1950).

The mercury photosensitized reactions of methy alcohol have been investigated at pressures of 30 and 100 mm Hg and over a temperature range from 25° to 500° c. Below 400° c the products are almost entirely hydrogen and ethylene glycol and small amounts of carbon monoxide, formaldehyde and methane. It has been established that the primary step in the reaction mechanism is $Hg(^3P_1) + CH_3OH \rightarrow CH_2OH + H + Hg(^1S_0)$. There is considerable supporting evidence that the alternative split into $H + CH_3O$ does not occur. Above 400° c the rates of production of CH_2O and CO become significant and increase with rising temperature which has been explained by the fact that the decomposition of the CH_2OH radical is taking place. An activation energy of 29 kcal. has been obtained for this decomposition reaction.

A

DISPERSIONS . COLLOIDS ADSORPTION 541.18

541.18.025

)5. Electrically controlled thixotropy. H. E. LLMANN. *Technik*, **5**, 173–6 (*April*, 1950) *In rman.*

A qualitative description of magnetic and electric xotropy and some of their applications.

J. E. CAFFYN

541.182 : 537.531

)6. Micelles and X-rays. W. PHILIPPOFF. *Coll. Sci.*, **5**, 169–91 (*April*, 1950).

After summarizing the main points in previously blished work on the X-ray analysis of isotropic lutions of soaps and other detergents the possible ructures of the micelles are discussed. Some new perimental data are given and simple geometrical rmulae are derived to relate the concentration to e long spacings observed. It is concluded that a mplete theory of micellar structure is not yet ssible. J. IBALL

541.182.2/.3

)7.* An observation chamber for ultramicroscopic vestigations on aerosols. O.-E. SCHWECKENDIEK. *Naturforsch.*, **5a**, 153–6 (*March*, 1950) *In German.*

The chamber consists of 3 Cu blocks $15 \times 15 \times 5$ cm ch laid one above the other. In the middle block chamber is provided of volume $5 \times 5 \times 5$ cm through hich the aerosol is sucked. On either side of the amber 2 coaxial conical openings are arranged lled with diluted $CuSO_4$ solution which acts as a heat ter. Through these openings passes the light of a p. Hg lamp with a brightness of 200 000 stilb rough a shutter and a slit. A 3rd similar opening erpendicular to the others serves for making bservations and for taking photographs. Distribution curves for 2 different aerosols taken at ifferent times show the shift from smaller to larger article sizes due to ageing. R. NEUMANN

541.182.3 : 537.24

A dust electricity analyzer. *See Abstr.* 6488

541.182.6.041

)8. Mechanical analysis based on sedimentation tudies. D. GUINEA. *An. Real Soc. Esp. Fis y Quim.*, **5A**, 577–86 (*Nov.–Dec.*, 1949) *In Spanish.*

Considering a suspension in which no agglomeration exists, the temperature is uniform, and the motion f the particles is uniform, the sedimentation is tudied theoretically and a formula is derived for the istribution (no. of particles of diameter between a nd $a - da$). Applications to experimental determinaons with microbalance, Wiegner tubes, buoyancy ethods, aerometer and turbidimeter are given.

J. A. WILCKEN

541.183

)09. Orientation of a polyfunctional organic olecule at a steel surface. N. HACKERMAN AND . E. GLENN, JR. *J. Phys. Coll. Chem.*, **54**, 497–505 *April*, 1950).

An investigation of the adsorption–desorption haracteristics of a commercial corrosion inhibitor as carried out. It was found that adsorption of this hibitor on to a steel surface was more firm from the more dilute solutions within the concentration range studied. Gradual fading of the arc pattern due to the inhibitor molecules on the steel surface was noted. Lines caused by the path of the electron beam across the inhibitor-surfaced metal were observed. A possible mechanism for the more firm adsorption from more dilute solutions and an explanation for the fading of the diffraction pattern and the lines on the metal block were presented. A.

541.183

6810. Derivation and development of Hüttig's multilayer sorption isotherm. R. R. FERGUSSON AND R. M. BARRER. *Trans. Faraday Soc.*, **46**, 400–7 (*May*, 1950).

A statistical derivation has been given of the most generalized form of sorption isotherm based on Hüttig's view of the evaporation-condensation properties of a sorbed molecule. From this general equation a number of characteristic isotherm equations have been obtained analogous to the various modifications of the B.E.T. isotherm. From calculations based upon these Hüttig-type multilayer sorption isotherms it has been shown possible to obtain curves corresponding to isotherms of types I, III and to some extent V, of Brunauer's classification, but not to types II and IV. It is also possible to obtain limiting values of the sorption corresponding to less or much more than the two layers given by Hüttig's original isotherm equation. A.

541.183 : 532.613.5 : 536.7

6811. Thermodynamics of adsorption from solutions. III. Adsorption at liquid–air interfaces. YING FU AND F. E. BARTELL. *J. Phys. Coll. Chem.*, **54**, 537–46 (*April*, 1950).

Adsorption of butyl alcohol, butyric acid, phenol, resorcinol, valeric acid, and caproic acid at water–air interfaces has been calculated from surface tension data by means of the exact form of Gibbs' equation. Activity coefficients, surface molalities, molecular areas and surface pressures have been calculated and plotted. These curves are entirely similar to those obtained for the solid–liquid interfaces. The adsorption of butyl alcohol, butyric acid and phenol is monolayer; that of resorcinol, valeric acid and caproic acid is multilayer. A.

541.183 : 542.9

6812. The mechanism of the decomposition of N_2O on ZnO as catalyst. M. BOUDART. Letter in *J. Chem. Phys.*, **18**, 571–2 (*April*, 1950).

A note discussing the relation between activated adsorption and the (electrical) conductive properties of the adsorbent, with special reference to the effect of Ga_2O_3 in ZnO catalysts. J. D. CRAGGS

541.183.2

6813. Application of Ursell and Mayer's treatment for imperfect gases to adsorption. S. ONO. Letter in *J. Chem. Phys.*, **18**, 397 (*March*, 1950).

541.183.26

6814. Adsorption of ammonia on surfaces of oxides. G. W. A. RIJNDERS AND G. C. A. SCHUIT. *Rec. Trav. Chim. Pays-Bas*, **69**, 668–70 (1950).

The adsorption of NH_3 as a function of temperature and pressure on some oxides and oxide mixtures was studied. The adsorption can be separated in two

processes; one with a high adsorption energy and entropy, the other with a much lower adsorption energy and entropy. A tentative explanation is suggested. A.

CHEMICAL STRUCTURE 541.4/.6

541.63

6815. An activated bromide study of the relative mobilities of the atoms in ββ′-dichlorodiethyl sulphide (yperite) and oxide. Buu Hoï, P. Jacquignon, G. Morin and R. Muxart. *C.R. Acad. Sci., Paris*, **230**, 1600–1 (*May* 3, 1950) *In French.*

By means of exchange reactions with activated NaBr, the Cl atoms in the yperite (mustard gas) molecule are found to be about 20× as mobile as those in the oxygen analogue; this is ascribed to greater hyperconjugation. H. H. HODGSON

541.64

6816. Studies in plasticization of polyvinyl chloride. I. Physical changes and their measurement. M. L. Dannis. *J. Appl. Phys.*, **21**, 505–9 (*June*, 1950).

The softening of a hard resin, polyvinyl chloride, by a liquid, dioctyl phthalate, is a set of processes occurring in sequence. Imbibition of the liquid is accompanied by volume reduction in the system. Dilatometer methods evaluate the amount and rate of volume decrease. The rate is temperature-dependent, activation energy about 80 kcal. Solution of liquid into the resin follows with no further volume, but large dielectric change. Dielectric changes are measured on material in a cylindrical condenser, using a Schering bridge, and are rate-dependent, activation energy about 110 kcal. Data are best described, assuming that segments of the polymer molecule "react" independently of one another. A.

541.64

6817. Studies in plasticization of polyvinyl chloride. II. Plasticizer variations in PVC-plasticizer systems. M. L. Dannis. *J. Appl. Phys.*, **21**, 510–13 (*June*, 1950).

Polyvinyl chloride resin is softened by certain liquids, called plasticizers, through a set of processes with high activation energies, 50–100 kcal. At fixed temperature, "reaction" rates are directly proportional to vapour pressure of the liquid. The dielectric change may be treated similarly to a chemical reaction between a solid and a vapour, and free energy activation, ΔF^{**}, evaluated. ΔF^{**} is constant various liquids with one resin. $\Delta E^{**} = \Delta H^{**}$ in this system, where ΔE^{**} is Arrhenius activa energy, ΔH^{**} energy barrier, L latent heat vaporization of the liquid.

CHEMICAL ANALYSIS 543/545

54

6818. Determination of helium content of rock samples. B. Karlik and F. Kropf-Duschek. *Phys. Austriaca*, **3** (*No.* 4) 448–51 (1950) *In Germ*

545.8 : 539.

6819. Neutron spectroscopy for chemical analy III. T. I. Taylor and W. W. Havens, Jr. *Nucleon* **6**, 54–6 (*April*, 1950).

The applications of thermal neutrons with a br energy distribution are described. Analysis of samp by transmission method is outlined and total cr sections of elements for thermal neutrons are giv in a table. The determination of H in vari materials by this method is considered in some det Analysis by absorption and activation methods is a reviewed and activation cross-sections of many of t stable isotopes, with details of the product activit are tabulated. L. R. SHEPHE

545.81 : 535.2

6820. Simultaneous spectrophotometric determi tion of cobalt, copper, and iron. R. E. Kitso *Analyt. Chem.*, **22**, 664–7 (*May*, 1950).

An examination of the thiocyanate-acetone syst led to the development of a colorimetric method f the simultaneous determination of Co, Cu and F The method involves development of colour in single solution followed by spectrophotometr measurements at 3 wavelengths: 380, 480 and 625 m The procedure is simple, rapid and free of serio interferences, but it is not applicable to amounts Cu smaller than 50 micrograms. A modified pr cedure was developed for the specific determinati of Co.

545.82 : 535.343.4–1

6821. Infrared spectrometric determination of deute ium oxide in water. V. Thornton and F. E. Condo *Analyt. Chem.*, **22**, 690–1 (*May*, 1950).

CRYSTALLOGRAPHY 548

548 : 669

Progress in metal physics. *See Abstr.* 6947

548.0 : 535.371

Remarks on the mechanism of phosphorescence in crystals. *See Abstr.* 6388

548.0 : 536.48 : 535.37

The fluorescence of mixed crystals of silver halides. *See Abstr.* 6397

548.0 : 537.226.2 : 539.32

6822. Dielectric constants and elastic moduli of uniaxial crystals. D. A. A. S. Narayana Ra Letter in *Curr. Sci.*, **19**, 116 (*April*, 1950).

548.0 : 537.311 : 535.34

6823. Electrical and optical properties of vanadiu pentoxide crystals. J. Boros. *Z. Phys.*, **126** (*N* 10–12) 721–4 (1949) *In German.*

The specific conductivity of single, synthet crystals of V_2O_5 hardly changes with heat treatme in different atmospheres, in contrast to most oth semi-conductors. Similar agreement between t

mally determined work function (0·4 eV) and optical absorption constant K is found as for O. K has maxima at 3·1 μ (0·4 eV) and 1·55 μ (8 eV) respectively. G. F. J. GARLICK

548.0 : 538.221

erromagnetic resonance absorption in magnetic le crystals. *See Abstr.* 6648

548.535 : 549 : 541.65

4. The formula of Lorentz–Lorenz and its lications to crystallography and mineralogy. BRASSEUR. *Bull. Soc. Roy. Sci. Liège*, **18**, 137–46 *arch–April*, 1949) *In French.*

he formula is $M/\rho \,.\, (n^2 - 1)/(n^2 + 2) = \Sigma_i C_i R_i$ ere M is the molecular weight, ρ the specific vity, n the index of refraction and C_i the molecular ncentration of the molecular constituent of ractivity R_i. It can be used to predict the indices refraction and birefringence of crystals of known ucture, to find the orientation of unsymmetric ups in crystals of known refractive index, and to d, e.g., the degree of hydration in minerals of certain composition. A. J. C. WILSON

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7 : 530.162

25. Crystal statistics of a two-dimensional Ising tice. G. F. NEWELL. *Phys. Rev.*, **78**, 444–50 *lay* 15, 1950).

The partition function Z of a two-dimensional ng lattice is evaluated by expressing it in the form $= \Sigma_i \lambda_i^{nm}$ where λ_i are the eigenvalues of a -dimensional matrix **M**, n is the number of rows d m the number of columns of the lattice. **M** is a neralization of the V-shaped matrix studied by ramers and Wannier in connection with the same oblem. It is shown that **M** can be expressed in ms of 2^n-dimensional representations of 2^n-mensional orthogonal matrices. The eigenvalues **M** are determined for n large by making use of the own relations between the eigenvalues of a -dimensional orthogonal matrix and the eigenvalues its 2^n-dimensional representative. The lattice nsidered differs only slightly from that treated by nsager and Kaufman. In the lattice considered re, the boundary effects are eliminated by intro- cing an interaction between the last lattice point each row and the first point of the next row. The atrix **V** considered by Onsager and Kaufman is, cept for the boundary effects, equivalent to the atrix $\mathbf{M}^n$. Z is shown to differ from the partition nction calculated by Onsager and Kaufman only in der n^{-2}. A.

548.7 : 534.1 : 536.62

26. Isotope effect in the vibrational frequency ectra and specific heats of sodium hydride and uteride. E. V. SAYRE AND J. J. BEAVER. *J. Chem. ys.*, **18**, 584–94 (*May*, 1950).

The prediction by the Born and von Karman tice dynamics theory of the effect of isotopic substitution on crystal vibration frequencies has been determined by calculation of frequency spectra of NaH and NaD. In each case 6 690 of the lattice frequencies have been calculated with the aid of I.B.M. punched card computers. They have been chosen and weighted in such a way that the whole frequency spectra of the crystals are uniformly sampled. Both spectra exhibit acoustical branches which are nearly identical and optical branches, the frequencies of which are essentially in the ratio of the square root of 2. In both cases, the optical branches extend somewhat uniformly over very broad ranges of frequencies, in marked contrast to the estimation of optical frequencies as a few monochromatic lines. The molar heat capacities of these two compounds have been determined experimentally between 60 and 90°K with an adiabatic calorimeter and compared to corresponding curves calculated from the frequency spectra. The theoretical and experimental sets of curves possess the same general form. In both cases the deuteride values are higher than the hydride values, with the curves of the two substances diverging with increasing temperature. The theoretical curves, however, are nearly uniformly displaced from the experimental curves by about 10%, an effect which could have arisen from an error in the repulsive force constants. A.

548.7 : 536.41

6827. Thermal expansion in silver halides. A. W. LAWSON. Letter in *Phys. Rev.*, **78**, 185 (*April* 15, 1950).

Strelkow [*Phys. Z. Sowjetunion*, **12** (*No.* 1) 23–82 (1937)] has observed an anomalous increase in the thermal expansion of AgCl and AgBr just below their melting points. It is suggested that this is a result of the increasing number of lattice defects with increasing temperature, and an attempt is made to distinguish between the Frenkel mechanism (interstitial Ag^+ ions and vacant + sites) and the Schottky mechanism (pairs of vacant + and − sites) from the magnitude of the effect. For AgBr the Schottky mechanism is favoured; for AgCl the effect is smaller and indecisive. A. J. C. WILSON

548.7 : 537.533.8

"Bremsstrahlung" in crystals. *See Abstr.* 6548

548.73 : 538.22

Relation between the crystal structure and magnetic properties of mixed nickel–zinc ferrites. *See Abstr.* 6644

548.73 : 538.221

6828. Magnetic properties and structure of the tetragonal phase of Cu ferrite. L. WEIL, F. BERTAUT AND L. BOCHIROL. *J. Phys. Radium*, **11**, 208–12 (*May*, 1950) *In French.*

An X-ray diffraction study of Cu ferrite suggests the existence of a super-lattice corresponding to an ordered arrangement of Cu and Fe ions on octahedral sites. The magnetic properties of the material, particularly the coercive force, are shown to vary with the heat-treatment received, as is the axial ratio of the tetragonal structure. Both these effects are attributed to the development of the super-lattice. A. E. DE BARR

548.733 : 536.48

6829. Low temperature X-ray diffraction apparatus. D. F. CLIFTON. *Rev. Sci. Instrum.*, **21**, 339–42 (*April*, 1950).

When studying transformations at sub-zero temperatures it is often convenient to be able to carry out treatments such as cold-working and annealing and to transfer the specimen, at temperature, to the X-ray diffraction camera. Several cameras have been designed, primarily for the X-ray spectrometer, in which this is easily done. For constant temperature work a flask, having a nozzle which allows cold liquid to flow over the specimen, is used. The holder is such that the specimen can be put in, in correct alignment, while in a cold bath. Two types of cameras giving variable temperatures are described. One, using cold gas blown over the specimen for cooling, permits putting the specimen in place under liquid N and keeping it at this temperature while it is aligned in the spectrometer. Rapid changes and accurate control in the range up to nearly room temperature are possible. A more versatile camera with a working range from 77°K to over 375°K uses liquid N as a coolant. Temperature control is by balancing the heat conduction along a tube with a heater near the specimen. This camera allows inserting the specimen at any chosen temperature in the working range but does not allow as rapid temperature changes in the cold gas camera. A.

548.735.4 : 518.5

Two aids for the calculation of crystal structure factors. *See Abstr.* 6196

548.736.184

6830. On black selenium. II. The lattice distortion of hexagonal selenium. H. KREBS. *Z. Phys.*, **126** (*No.* 10–12) 769–80 (1949) *In German.*

The X-ray line breadths given by Se layers (as used in rectifiers) were measured after various heat treatments. It was found that $\beta \cot\theta$ was nearly independent of *hkl*, but $\beta \cos\theta$ varied widely, indicating that the broadening was due to strain rather than small crystal-size. The range of a calculated from the breadths varied from $\sim 4\%$ after tempering at 74° to $\sim 1\%$ after tempering at 210°. The range of c was considerably smaller. The mean lattice parameters at 20°C showed variations round $a = 4{\cdot}36$, $c = 4{\cdot}949$ depending on the source and heat treatment of the Se; values obtained with a high temperature camera are: 130°C, $a = 4{\cdot}397$, $c = 4{\cdot}945$; 210°C, $a = 4{\cdot}421$, $c = 4{\cdot}943$ *kX*(?), confirming the negative coefficient of expansion $\| c$. It is concluded that hexagonal Se is a high polymer of micellar structure.

A. J. C. WILSON

548.736.3

6831. On the crystal structure of the disilicides of lanthanides. G. BRAUR AND H. HAAG. *Naturwissenschaften*, **37** (*No.* 9) 210–11 (1950) *In German.*

Preliminary note on $MeSi_2$ (Me = La, Ce, Pr, Nd, Sm). Structure similar to $ThSi_2$; a and c dimensions given.

548.736.3

6832. An X-ray study of the rare-earth oxide systems: Ce^{IV}–Nd^{III}, Cr^{IV}–Pr^{III}, Ce^{IV}–Pr^{IV} and Pr^{IV}–Nd^{III}. J. D. MCCULLOUGH. *J. Amer. Chem. Soc.*, **72**, 1386–90 (*March*, 1950).

Solid solutions with the fluorite structure are formed in all cases and lattice constants have determined as a function of composition. For oxide systems M^{IV}–M^{III} there is an upper solub limit varying from 50 to 67 atomic % of the triv metal. Pr is readily oxidized to Pr^{IV} in the pres of Ce^{IV}, but with more difficulty in the pres of Nd^{III}. In no case is there evidence for the o tion of Pr beyond the +4 state, even under O press as high as 50 atmos. Evidence is given in suppo the existence of Pr_6O_{11} as a separate and dis phase in the Pr–O system.

548.7

6833. The crystal structures of CeB_4, ThB_4, UB_4. A. ZALKIN AND D. H. TEMPLETON. Lette *J. Chem. Phys.*, **18**, 391 (*March*, 1950).

548.7

6834. On the crystalline structure of the mangan dioxides. J. BRENET. *C.R. Acad. Sci., Paris*, 1360–2 (*April* 3, 1950) *In French.*

548.7

6835. The crystal structure of Mo_3Si. D. TEMPLETON AND C. H. DAUBEN. *Acta Cryst.*, 261–2 (*July*, 1950).

The structure has been determined from pow diffraction patterns. The lattice is cubic v $a = 4{\cdot}890 \pm 0{\cdot}002$ Å. The structure is that β-wolfram and the compound is isostructural w Cr_3Si and V_3Si.

548.73

6836. Crystal structure of nitric anhydride, N_2 E. GRISON, K. ERIKS AND J. L. DE VRIES. *Acta Cry* **3**, 290–4 (*July*, 1950) *In French.*

Crystals of N_2O_5 are ionic with the composit $(NO_3)^-(NO_2)^+$. The space group is D^4_{2h}–$C6/m$ and the cell dimensions are $a = 5{\cdot}41$, $c = 6{\cdot}5$ (at about − 60°c); $a = 5{\cdot}45$, $c = 6{\cdot}66$ Å (at abo 20°c). The distance N–O is $1{\cdot}24_3 \pm 0{\cdot}01$ Å in ion $(NO_3)^-$ and $1{\cdot}15_4 \pm 0{\cdot}01$ Å in the ion $(NO_2)^+$.

548.73

6837. The crystal structure of $LaSi_2$. F. BERTA AND P. BLUM. Note in *Acta Cryst.*, **3**, 319– (*July*, 1950) *In French.*

548.73

6838. The crystal structure of sodium nitrate a the atomic scattering factors of the atoms in t nitrate group. P. E. TAHVONEN. *Ann. Acad. S Fennicae*, *Ser. A*1 (*No.* 42) 25 *pp.* (1947) *In Germa*

The intensity of the powder diffraction maxima room temperature was measured by the methods Wasastjerna [Abstr. 1980–2 (1947)] with NaCl as internal standard and correction for preferred orient tion. The parameter u fixing the positions of t O atoms was found to be $0{\cdot}242 \pm 3$, giving the N- distance 1·22 Å. The r.m.s. vibration amplitudes the atoms were found to be 0·21, 0·23, 0·24 ± 1 for Na, N, O respectively. The atomic scatteri factors for the atoms at rest were:—

$10^{-8} \sin\theta/\lambda =$

	0·0	0·1	0·2	0·3	0·4	0·5	0·6	0·
Na	10·12	9·80	8·59	6·60	5·14	4·05	3·31	2·
N	7·0	6·28	4·81	3·33	2·44	1·92	1·66	1·
O	8·33	7·62	5·96	3·98	2·88	2·22	1·78	1·

These are in good agreement with those found Wasastjerna for Na and by Pauling and Sherman f

and O, but are somewhat > those of James and indley for N and O. A. J. C. WILSON

548.736.4

339. X-ray investigation of molecular rotation in e $NaNO_3$ crystal. P. E. TAHVONEN. *Ann. Acad. i. Fennicae, Ser. A1* (*No.* 43) 19 *pp.* (1947) *In erman.*

See preceding Abstr. At 290 ± 1°C the lattice arameters are $a = 6{\cdot}55 \pm 1$ Å, $\alpha = 45°\,33 \pm 1'$, ith the NO_3 groups rotating about the trigonal axis. ecause the O atoms have to make their way among Na atoms, the rotation is coupled with a vibration, arallel to the trigonal axis, of 3 times the frequency. he vibration amplitude is 0·2–0·3 Å.

A. J. C. WILSON

548.736.4

340. X-ray investigation of molecular rotation in ie KNO_3 crystal. P. E. TAHVONEN. *Ann. Acad. ci. Fennicae, Ser. A1* (*No.* 44) 21 *pp.* (1947) *In erman.*

At 152 ± 1°C the lattice parameters are $a = {\cdot}18 \pm 1$ Å, $\alpha = 44°\,8{\cdot}5 \pm 1{\cdot}0'$. The vibration mplitude [Abstr. 6839 (1950)] of the NO_3 group is ·40 ± 4 Å. A. J. C. WILSON

548.736.4

841. The crystal structure of ammonium trinitrate, $NH_4NO_3 . 2HNO_3$. J. R. C. DUKE AND F. J. LEWELLYN. *Acta Cryst.*, **3**, 305–11 (*July*, 1950).

548.736.4 : 537.531 : 535.36

842. The diffuse scattering of $NaClO_3$. M. S. HMED AND K. LONSDALE. *Acta Cryst.*, **3** (*No.* 3) 41–2 (1950).

The photographic experiments of Garrido [Abstr. 710 (1948)] on the diffuse scattering are repeated, n order to clear up the discrepancy between them nd the Geiger-counter measurements of Rama-handran and Wooster [Abstr. 3537 (1950)]. It is ound that Garrido's photographs are repeatable, but hat they were wrongly interpreted. The correct nterpretation, accepted by Garrido, is in complete greement with the Geiger-counter investigation and confirms the thermal theory of the diffuse scattering.

A. J. C. WILSON

548.736.5

843. Crystal structure of ammonium dihydrogen phosphate $NH_4H_2PO_4$. R. UEDA. *J. Phys. Soc. Japan*, **3**, 328–33 (*Sept.–Dec.*, 1948).

548.736.5

844. X-ray investigation of ammonium thiocyanate. Z. V. ZVONKOVA AND G. S. ZHDANOV. *Zh. Fiz. Khim.*, **23**, 1495–1501 (1949) *In Russian.*

Monoclinic, $P2_1/c$, $a = 4{\cdot}3$, $b = 7{\cdot}2$, $c = 13{\cdot}0$ Å, $\beta = 97°40'$, $Z = 4$, co-ordinates S: (0·992, 0, 0·195), N: (0·165, 0·714, 0·061), C: (0·086, 0·840, 0·120), NH_4: (0·442, 0·333, 0·111), and positions related by the symmetry elements. A. J. C. WILSON

548.736.5

845. The crystal structure of Ramsayite $Na_2Ti_2Si_2O_9$. N. V. BELOV AND L. M. BELYAEV. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 6) 805–8 (1949) *In Russian.*

The unit cell of Ramsayite is orthorhombic (space group $V_h^{14} = D_{2h}^{14} = Pnca$) with $a = 14{\cdot}26$, $b = 8{\cdot}57$ and $c = 5{\cdot}09$ Å. The density 3·38 — 3·43 gives $Z = 4$. The b and c dimensions are comparable with those of the pyroxene enstatite and a with that in diopside. A trial structure which required little correction from Patterson and Fourier projections was built up using packing considerations and by analogy with the pyroxenes. Chains of Ti-octahedra run through the structure as in anatase and brookite. The atomic parameters (x, y, z), in hundredths of the cell edges are:—Ti(8), (16·8, — 15·1, 13·5); Si(8), (2·3, 15·3, 19); Na(8), (15·2, 4·5, 65); O_1(8), (9, 17·7, 19); O_2(8), (7·2, 0·8, 26); O_3(8), (6·7, 23, 44); O_4(8), (23·2, — 17·5, 45); O_5(4), (25, 0, 2). A. L. MACKAY

548.736.5

6846. Crystal chemical studies of the 5*f*-series of elements. XII. New compounds representing known structure types. W. H. ZACHARIASEN. *Acta Cryst.*, **2**, 388–90 (*Dec.*, 1949).

548.736.5

6847. Crystal chemical studies of the 5*f*-series of elements. XIII. The crystal structure of U_2F_9 and $NaTh_2F_9$. W. H. ZACHARIASEN. *Acta Cryst.*, **2**, 390–3 (*Dec.*, 1949).

548.736.5

6848. The structure of fluoborite. Y. TAKÉUCHI. *Acta Cryst.*, **3** (*No.* 2) 208–10 (1950).

548.736.5

6849. Structure of β-tungsten oxide. A. MAGNÉLI. Letter in *Nature, Lond.*, **165**, 356–7 (*March* 4, 1950).

548.736.6

6850. A note on the crystal structure of the chlorite minerals. K. ROBINSON AND G. W. BRINDLEY. *Proc. Leeds Phil. Lit. Soc.*, **5**, 102–8 (*Dec.*, 1948).

548.736.6

6851. The lattice constant of quartz $11\bar{2}0$. G. BROGREN AND L.-E. HÆGGBLOM. *Ark. Fys.*, **2**, *Paper* 1, 1–3 (1950).

A spectrometer with photographic recording of the first and second orders gave $d = 2{\cdot}451445 \pm 25$ kX ($\lambda CuK_{\alpha_1} = 1{\cdot}537399$ kX) after correction for refraction. A. J. C. WILSON

548.736.6

6852. The lattice-parameters of clear crystalline quartz. H. D. KEITH. *Proc. Phys. Soc., Lond. B*, **63**, 208–14 (*March*, 1950).

Some experimental results are presented showing that the calibration of Debye–Scherrer X-ray diffraction cameras by means of clear crystalline quartz may lead to appreciable errors unless the parameters of the quartz are first determined by a direct method. The parameters of a sample of clear Brazilian quartz have been found to be in serious disagreement with the accepted values, and variations in the parameters of synthetic quartz, with an apparent dependence on growth temperature, have also been observed. Taken in conjunction with previous results of other workers, the experiments show that quartz parameters vary from sample to sample by amounts as large as 0·01% according to the impurity content. The previously proposed quartz calibration standard is rejected. A.

548.737

6853. Crystal structure of alkyl mercury halides. D. R. GRDENICH AND A. I. KITAIGORODSKIĬ. *Zh. Fiz. Khim.*, **23**, 1161–71 (1949) *In Russian.*

Tetragonal compounds are CH_3HgCl [$a = 4{\cdot}62$,

$c = 9{\cdot}39$ Å (?kX)], C_2H_5HgCl ($a = 4{\cdot}65$, $c = 10{\cdot}82$ Å), C_2H_5HgBr ($a = 4{\cdot}90$, $c = 10{\cdot}62$ Å) and C_3H_7HgCl ($a = 4{\cdot}70$, $c = 13{\cdot}62$ Å), all with space group $P4/nmm$ and $Z = 2$. C_4H_9HgCl is orthorhombic, space group Pmn, $Z = 2$, $a = 4{\cdot}10$, $b = 5{\cdot}34$, $c = 15{\cdot}16$ Å. Interatomic distances found by Fourier synthesis are Hg — Cl and Hg — Br = 2·50, Hg — C = 2·06 ± 3 Å. A. J. C. WILSON

548.737

6854. On the meaning of the X-ray diagrams of certain proteins. I. K. DORNBERGER-SCHIFF. *Ann. Phys., Lpz.* **5** (*No.* 1–2) 14–32 (1949) *In German.*

The mathematical theory of Patterson syntheses and $|F|^2$ plots for protein crystals of varying water content is developed. The X-ray and electron-microscope evidence for the structure of tobacco-mosaic virus [Bernal and Fankuchen, *J. Gen. Physiol.*, **25**, 111 (1941); Schramm, *Z. Naturforsch.*, **2b**, 113 (1947); Wyckoff, *Biochim. et Biophys. Acta*, **1**, 143 (1947)] is discussed in detail, and the models of Bernal and Fankuchen and of Schramm are rejected as inconsistent with the observed intensities. In a new model the protein molecules have the form of spiral staircases, interleaving in the crystal, and easily splitting into units of molecular weight 360 000 ($\frac{1}{3}$ of a rotation) and 120 000 ($\frac{1}{9}$ of a rotation). Other proteins are mentioned briefly. A. J. C. WILSON

548.737

6855. The molecular structure of thiophthen from X-ray crystal analysis. E. G. COX, R. J. J. H. GILLOT AND G. A. JEFFREY. *Acta Cryst.*, **2**, 356–63 (*Dec.*, 1949). Corrigenda: **3** (*No.* 3) 243 (1950).

548.737

6856. Crystal structure of silver salts of fatty acids. V. VAND, A. AITKEN AND R. K. CAMPBELL. *Acta Cryst.*, **2**, 398–403 (*Dec.*, 1949).

Seven Ag salts of even-numbered *n*-fatty acids were investigated by X-rays at 20 and at 78°c. Their unit cells were determined from powder photographs; they proved to be triclinic with two molecules of Ag salt per unit cell. At 20°c the unit cell varies gradually with chain length from $a = 4{\cdot}588$, $b = 4{\cdot}016$, $c = 20{\cdot}41$ Å, $\alpha = 101°\,12'$, $\beta = 102°\,28'$, $\gamma = 80°\,4'$ for silver caproate, to $a = 4{\cdot}693$, $b = 4{\cdot}120$, $c = 50{\cdot}35$ Å, $\alpha = 104°\,35'$, $\beta = 93°\,59'$, $\gamma = 76°\,1'$ for silver stearate. Changes of the unit-cell dimensions with temperature have been observed. A packing of the molecules in the unit cell is suggested. A.

548.737

6857. Crystal structure of the three polymorphic varieties of *N*-picryl-*p*-iodoaniline. E. GRISON. *Acta Cryst.*, **2**, 410–17 (*Dec.*, 1949) *In French.*

548.737

6858. The crystal structure of DL-alanine. II. Revision of parameters by three-dimensional Fourier analysis. J. DONOHUE. *J. Amer. Chem. Soc.*, **72**, 949–53 (*Feb.*, 1950).

548.

6859. The structures of the *n*-propylammonium halides at room temperature. M. V. KING AND W. LIPSCOMB. *Acta Cryst.*, **3** (*No.* 3) 222–7 (1950).

548.

6860. The crystal and molecular structure of triphenylene, $C_{18}H_{12}$. A. KLUG. *Acta Cryst.*, (*No.* 3)·165–75 (1950).

548.

6861. The crystal structure of *p*-dinitrobenzene. S. C. ABRAHAMS. *Acta Cryst.*, **3** (*No.* 3) 194–6 (195

548.

6862. The structure of tetraphenylmethane. H. SUMSION AND D. MCLACHLAN, JR. *Acta Cryst.*, (*No.* 3) 217–19 (1950).

548.

6863. The low-temperature modification of propylammonium chloride. M. V. KING AND W. LIPSCOMB. *Acta Cryst.*, **3** (*No.* 3) 227–30 (1950).

548.737 : 548.73

6864. Structure of acenaphthene and some questions of method in X-ray analysis. A. I. KITAĬGORODSKĬ. *Zh. Fiz. Khim.*, **23**, 1036–57 (1949) *In Russian.*

Orthorhombic, $a = 8{\cdot}3$, $b = 13{\cdot}98$, $c = 7{\cdot}3$ (?kX) $Z = 4$, space group $Pcm2_1$. Previous worke suggested $Pcmm$; this and $Pc2m$ with the san absences are excluded by packing. The molecul are planar with the $-CH_2-CH_2$-distance in th 5-ring increased to 1·64 Å and the breadth of th benzene rings reduced by strain. One- and tw dimensional Fourier syntheses, extinction, temperatu factor, and accuracy are discussed. A. J. C. WILSO

548.

6865. Electronographic determination of the structure of barium chloride monohydrate, $BaCl_2 . H_2O$. B. K. VAĬNSHTEĬN AND Z. G. PINSKER. *Zh. Fiz. Khim.*, **23**, 1058–69 (1949) *In Russian.*

Polycrystalline specimens with partial orientatio were investigated by electron diffraction. The ce was found to be orthorhombic, $a = 4{\cdot}51 \pm$ $b = 9{\cdot}02 \pm 2$, $c = 11{\cdot}28 \pm 3$ Å (?*k*X) density 3·27 $Z = 4$, with an *n* glide $\perp c$. As $b \simeq 2a$ other sym metry elements were not determinable with certainty but the probable space group $Pmcn$ was verified b agreement of calculated and observed intensities. Th *x* and *y* parameters were found by Patterson an Fourier projections on the *ab* plane, and the *z* para meters by trial and error to give the best intensit agreement. All atoms occupy the four-fold specia position $\frac{1}{4}yz$ and its equivalents, with *y* and *z* para meters Ba(0·115 ± 5, 0·18 ± 1), O(0·61 ± 1, 0·18 ± 1), Cl I(0·11 ± 1, − 0·12 ± 1), Cl II(0·645 ± 1 − 0·11 ± 1). A. J. C. WILSON

GEOPHYSICS 55

550.3 : 539.411

6866. On the compressibility of the earth. W. H. RAMSEY. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **6**, 42–9 (*March*, 1950).

The discussion is from the point of view of the theory of solids. It is shown that the bulk modulus K is approximately a linear function of the pressure p except at comparatively low pressures; this is the case in the earth. The derivative (dk/dp) at high pressures is closely related to the properties of the solid at low

ssures. It is explained why the derivative (dk/dp) s not change appreciably at the boundary of the e. The inner core of the earth is shown to be id. A.

550.31

7. An earth model based on a compressibility-ssure hypothesis. K. E. BULLEN. *Mon. Not. Roy. r. Soc.* (*Geophys. Suppl.*) **6**, 50–9 (*March*, 1950).

n this model there is a sharp density increase from 6 to 3·57 g/cm³ at a depth of 80 km, and there-er a fairly steady density gradient down to a depth 2 700 km; the gradient increases sharply in the t 200 km, the density being 5·57 g/cm³ at the base the mantle. The density inside the central core nges from 9·74 g/cm³ to 12·00 g/cm³ at a depth 4 980 km and then rises sharply, reaching a value tween 17 and 18 g/cm³ at the centre. Seismic waves would be transmitted through the inner core speeds close to 5·0 km/sec. The distributions of pressure p and certain other properties are shown tables, and an equation is given connecting p and incompressibility k for pressures between 0·4 d $3{\cdot}2\times10^{12}$ dynes/cm². Various uncertainties are scussed, and also the relation of the new model to earlier model. A.

550.31 : 525.2

8. Dynamic effects of a liquid core. H. JEFFREYS. *on. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 670–87 (1949). The effect of the inertia of the earth's core on the dily tides and related phenomena is examined. evious discussions, which have neglected this inertia, e found to be sufficiently accurate for the semi-urnal, fortnightly, and semiannual tides, but to need odification for those depending on terms of the rms zx, zy in the gravitational potential. A theory these is developed for an earth model of Wiechert pe, with a fluid core, and applied to the free variation latitude and the lunar nutation. It was known at with a rigid shell a fluid core would produce a ortening of the free period, in contradiction with servation; but it is found that with a shell of asonable rigidity ($1{\cdot}9\times10^{12}$ dynes/cm²) the motion duced in the core is much less than with a perfectly gid shell, and that agreement between theory and servation can be obtained with a rigidity differing tle from what was found satisfactory when the ertia of the core was neglected. Fluidity of the re has been seen to be capable of producing a duction of the amplitude of the lunar nutation out three times as large as is needed to account for e present discrepancy between theory and observa-n. Allowance for elasticity of the shell is found to duce this; allowance for the considerable obliquity the ecliptic further reduces the correction for the tation in latitude, but increases that for the nutation longitude. Even for the nutation in latitude the rrection remains too large, but possibly not too rge for the excess to be due to inaccuracies of the iechert model, and there is a need for a theory that kes account of the fuller knowledge now available the distribution of density and rigidity in the rth. A.

550.312

9. Values of gravity at stations in Southern Britain. A. H. COOK. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **6**, 9–27 (*March*, 1950).

550.34

6870. Contribution to the study of the so-called "principal phase" of a seismogram. S. MENIS AND C. MORELLI. *Ann. Geofis.*, **2**, 545–75 (*Oct.*, 1949) *In Italian.*

In the maximum phases of distant earthquakes the authors have identified Love waves but not Rayleigh waves. Harmonic analysis of the maximum phases of two chosen earthquakes revealed Love waves and a second component in the vertical plane normal to the plane of propagation. The elliptical nature of the earth movements and the rotation of the axes of the ellipses are attributed to local discontinuities in the earth's crust.

E. M. FOURNIER D'ALBE

550.34

6871. Contribution to the study of earthquakes. A. STOYKO. *Ann. Franç. Chronom.*, **4** (*No.* 1) 49–57 (1950) *In French.*

The motion of the pendulums at the Observatoire de Paris is sometimes interrupted by earthquakes. An analysis of the changes in motion due to 2 earthquakes in Switzerland in 1946 reveals that the pendulum supports underwent sudden displacements of the order of 11·2 and 7·2 mm. These shocks were sufficient to cause slipping of some of the pendulums relative to their supports. E. M. FOURNIER D'ALBE

550.34 : 534.154 : 621.317.39

6872. Recent vibration meters with electrical indication. H. KÖHLER. *Elektrotechnik, Berlin*, **3**, 301–10 (*Oct.*, 1949) *In German.*

The physical foundations of vibration measurement are briefly discussed. The 2nd order linear differential equation and its solution for the case of harmonic vibration are given. Graphs show the theoretical trend of amplitude and phase of the mass movement in its functional relation to excitation frequency for frequencies above and below resonance. A vibration table devised by the author for testing and calibrating vibration meters is described. Typical vibration meters are described and illustrated, viz., the Askania carbon contact-meter, the A.E.G. piezo-electric meter, the capacitive meter of Meister, the dynamic meters of Philips and of Reutlinger–Haymann, the piezo-electric meter of v. Thyssen, the "Geophone" of Siemens and Halske based on the microphone principle, and finally a highly sensitive piezo-electric meter devised by the author. Its development and its properties are described in detail. Sensitivity curves are given for the various designs from which it appears that a distinction may be made between meters of low sensitivity, mainly suitable for the investigation of machines and vehicles, and those of high sensitivity for seismological purposes, investigations of building ground, traffic disturbances and applications in mining. R. NEUMANN (R)

550.34 : 534.647

6873. Note on the magnification curve of a seismograph recording through a galvanometer. R. E. INGRAM. *Bull. Seism. Soc. Amer.*, **40**, 21–3 (*Jan.*, 1950).

550.34 : 621.315.094

6874. On the problem of the electrical transmission of seismic impulses over great distances through cable. W. BUCHEIM. *Geofis. Pura Appl.*, **16**, 81–6 (*Jan.–March*, 1950) *In German.*

When a pulse is transmitted it is both retarded and distorted because of the transmission constants of the cable. The case of parallel wires is considered and the distortion is calculated for a few typical examples. In the last section a distortion-free cable is calculated for a transmission distance of 20 km and is shown to cause a delay of about 0·01 sec

J. M. HOUGH

550.361 : 550.38

6875. The transfer of heat from the core of the earth. E. C. BULLARD. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **6**, 36–41 (*March*, 1950).

The dynamo theory of the origin of the magnetic field of the earth requires a motion of the material of the core. This paper discusses the possibility that the motion is due to thermal convection. Too little is known of the core for a definite answer to be obtained. It is shown, however, that reasonable values of the constants involved will give convection. The main difficulty is to arrange for removal of the heat from the outside of the core. A.

550.37 : 537.591.8

Cosmic radiation and the maintenance of a potential gradient in the atmosphere. *See Abstr.* 6623

550.38

6876. Measurement of the earth's magnetic field at high altitudes at White Sands, New Mexico. S. F. SINGER, E. MAPLE AND W. A. BOWEN. Letter in *Phys. Rev.*, **77**, 398–9 (*Feb.* 1, 1950).

Telemetered data from a compensated total-field magnetometer, carried in an Aerobee rocket to a height of 114 km, showed that the field decreases with altitude in accordance with potential theory, the maximum decrease being 28 mG compared with a theoretical value 26·9 mG. No evidence was obtained for the existence of circulating currents in the high atmosphere, the expected effect being too small at the geomagnetic latitude (41°) of the experiment, but the flight was a successful test of the method. A further flight is to be made at a more favourable location.

A. T. PRICE

550.38

6877. The terrestrial magnetic quadripole. A. CHARGOY. *J. Geophys. Res.*, **55**, 47–9 (*March*, 1950) *In Spanish.*

A determination of the plane containing the earth's magnetic quadripole. The solution is immediate from the definition of the geomagnetic centre given by Thomson. It is shown that this coincides with the geomagnetic equator. A.

550.38 : 550.4

6878. The earth's interior and geomagnetism. W. M. ELSASSER. *Rev. Mod. Phys.*, **22**, 1–35 (*Jan.*, 1950).

A summary of present knowledge of the composition and properties of the earth's interior, derived from geochemistry, seismology, geodynamics, geothermal studies, and geomagnetism, with special reference to the dynamo theories of the earth's magnetism, developed by Elsasser and Bullard. liquid core revealed by seismic data is proba composed mainly of Fe with possibly some hea elements concentrated near its centre. The ou mantle consists almost wholly of silicates of Fe Mg, with a preponderance of the latter. Theoret considerations and extrapolation from Bridgema experimental results on high pressure effects do support Ramsey's suggestion that the earth is uniform composition, with the denser liquid c representing only a phase transition due to press The earth's magnetic field is ascribed to elec currents flowing in the metallic fluid core, maintained by induction effects caused by motion the fluid in the magnetic field. The only poss source of the fluid motions appears to be therm convection due to localized production of heat radioactivity. There are possibly both large c vective motions such as those in Bullard's sugges feedback mechanism and small-scale turbulence suggested by Elsasser. A. T. PR

550.384 : 551.

6879. On the relation between variations of earth's magnetic field and variations of the large-sc atmospheric circulation. O. R. WULF AND M. HODGE. *J. Geophys. Res.*, **55**, 1–20 (*March*, 1950)

550.83 : 551.46 : 55

6880. The meteorological and oceanographic aspe of geophysical prospecting. A. H. GLENN A C. C. BATES. *Geophysics*, **15**, 247–56 (*April*, 1950)

550.

6881. On the uniqueness of the solution of problem of electro-prospecting. A. N. TIKHON *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 6) 797–800 (19 *In Russian.*

550.8

6882. A new principle of electrical depth-soundi W. BUCHHEIM. *Geofis. Pura. Appl.*, **16**, 76–80 (*Ja March*, 1950) *In German.*

A new method of electrical depth-sounding proposed, using a variable frequency and unchang position of electrodes and sondes.

550.

6883. Concerning a determination by W. Thoms of the age of the earth. L. CASTOLDI. *Atti Acc Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **3**, 561 (*Nov.–Dec.*, 1947) *In Italian.*

Thomson's estimate of the age of the earth (1 million years) from the geothermal gradient is n appreciably modified by correction for the spheric of the earth or for the rate of loss heat from t surface. E. M. FOURNIER D'AL

550.

6884. Geologic age from metamict minerals. H. HOLLAND AND J. L. KULP. *Science*, **111**, 3 (*March* 24, 1950).

551

6885. On the elastic resistance of the earth's cru E. NISKANEN. *Ann. Acad. Sci. Fennicae, Ser. A* (*No.* 21) 21 *pp.* (1949).

The uplift of land in Fennoscandia is studied the basis of the following assumptions: The crust the earth is supposed to be elastic and the underlyi magma a very viscous fluid. Owing to the "cree

d decay of the elastic resistance of the crust, after a ficiently long time the crust will rise to the level ceding the Glacial epoch. Assuming the modulus rigidity of the crust to be greater than normal $= 5 \cdot 4 \times 10$ dyne/cm² is used) the conclusion can drawn that about 8 000–8 500 yr ago the surface the earth had reached the niveau, which it could ver exceed because of the rigidity of the crust. e later upheaval is due to the very slow decay of the esses in the crust. The upheaval before the time entioned has been very violent according to geo- gical facts (up to 40–50 m in a century), and this ves support to the assumption that the viscosity of e subcrustal magma is considerably less than the lues computed before. The violent uplift of the ust may be partly due to the vanishing of the elastic mpression. The value obtained for the viscosity of e subcrustal magma is $\mu_2 = 5 \times 10^{21}$ gcm^{-1} sec^{-1} of e same order as earlier results. A.

551.1

886. On the densities and pressures in the earth's nterior. L. L. CALVO. *Rev. Geofis.*, **8**, 431–48 *Oct.–Dec.*, 1949) *In Spanish.*

A discussion on the relative advantages of different ethods of studying pressure and density distribution s a function of depth. Employing the hydrostatic ypothesis the pressure at different depths is calculated ithout involving constants, density or gravity. The sults obtained are compared with those of earlier orkers. A. C. COPISAROW

551.46

887. Heat-flow below the oceans. A. E. BENFIELD. etter in *Nature, Lond.*, **165**, 445 (*March* 18, 1950).

ATMOSPHERE . METEOROLOGY 551.5

551.508

888. A study of the accuracy of measurements of he Väisälä radiosonde. L. RAAB AND N. RODSKJER. *Ark. Geophys.*, **1**, Paper 2, 33–41 (1950).

In this investigation the results from a number of lights with two sondes fixed at different distances rom the balloon have been examined. The evaluated alues from the lower sonde were first reduced to the evel of the upper. The difference Δ, between the two ecords in each flight was then expressed as the sum f three terms, (1) Δ_b (due to the balloon), (2) Δ_s (due o sonde-errors e_s' and e_s'') and (3) Δ_t (due to dispersion rrors, i.e. errors in recording and evaluation, e_t' and e_t'') where e' refers to the first record, e'' to the second. he separation of these effects then permitted the alculation of the errors. Each flight has been divided nto 4 intervals, 1 000–600 mb, 600–350 mb, 350–50 mb and above 150 mb, Δ_s and Δ_t, calculated for ach flight and for each interval, and in addition the m.s. values μ_s and μ_t for e_s and e_t. All values so btained have been tabulated. The graph illustrating he variation in Δ_b with height shows a remarkable end in the region of the tropopause. The greater urbulence below the tropopause compared with that bove has been suggested as a reason for this.

A. E. M. GEDDES

551.509.59

6889. An objective determination of probability of fog formation. L. BERKOFSKY. *Bull. Amer. Met. Soc.*, **31**, 158–62 (*May*, 1950).

A method of approach to objective fog forecasting, based on the use of probability charts is suggested. Given 2 parameters, say wind speed and dew-point depression, at sunset, as ordinate and abscissa of a chart, occurrences and non-occurrences of fog following sunset are plotted as functions of these parameters. Isolines of relative frequency are drawn, giving a probability chart. Two more such charts, using 4 additional parameters, are constructed, and a total probability of fog occurrence following sunset is computed as a linear function of the 3 individual probabilities. This result is used as a criterion for the forecast. Time of formation equations are developed, to be applied when a fog proves to be likely. A.

551.510.4

6890. The evolution of the earth's atmosphere. H. SPENCER JONES. *Sci. Progr.*, **38**, 417–29 (*July*, 1950).

A comprehensive account of information on relative cosmic and terrestrial abundances of elements. Theories of evolution of the present atmosphere are considered and conclusions drawn.

551.51

6891. Physics and the atmosphere. G. M. B. DOBSON. *Proc. Phys. Soc., Lond. B*, **63**, 252–66 (*April*, 1950).

A review of some of the outstanding problems in the physics of the atmosphere: a detailed account is given of recent work on atmospheric ozone, on the humidity of the upper atmosphere and on the ice-forming nuclei in the atmosphere.

E. M. FOURNIER D'ALBE

551.510.535

6892. Solar influence on the normal *E* layer of the ionosphere. E. HARNISCHMACHER. *C.R. Acad. Sci., Paris*, **230**, 1301–2 (*March* 27, 1950) *In French.*

Long series of critical frequency data [f_c] for the normal E layer for a number of stations, have been examined in relation to the equation $f_c = K \cos^n \chi$ [χ = solar zenith angle]. Best values of K and n are determined and expressions showing the dependence of these constants on latitude and sunspot number are given. W. J. G. BEYNON

551.510.535

6893. Theory of the production of an ionized layer in a non-isothermal atmosphere neglecting the earth's curvature, and its application to experimental results. J. A. GLEDHILL AND M. E. SZENDREI. *Proc. Phys. Soc., Lond. B*, **63**, 427–45 (*June*, 1950).

A new theory of ionospheric layer formation is developed, in which the temperature is assumed to vary linearly with height. The equations are compared at each step with those obtained by Chapman in his theory of layer formation in an isothermal atmosphere. The equations for the maximum of electron density and its height are also given. The effect of the parameters on the shape of the layer is shown in graphical form. The equations are somewhat complex in form, but an ingenious graphical method has been devised suitable for the application of the theory to results given in the form of a Booker

and Seaton parabolic distribution of electronic density with height. By application of the theory to mean hourly values for 4 summer months in South Africa, values are obtained for the temperature gradient, the temperature at 200 km, and its variation over the middle part of the day. The results obtained are in accordance with previous estimates and offer numerical confirmation of the theory that the atmosphere expands bodily upwards during the middle part of a summer day. A.

551.510.535 : 621.396.11

6894. The origin of the Mögel–Dellinger effect. H. SIEDENTOPF. *Arch. elekt. Übertragung*, **4**, 97–8 (*March*, 1950) *In German.*

It is suggested that high-energy protons emitted during solar eruptions may indirectly give rise to radiation of wavelength 1 or 2 Å, which in turn produces intense ionization in the lower part of the ionosphere. W. J. G. BEYNON (R)

551.511 : 536.75

6895. Entropy of the atmospheric air. Theoretical and practical bases for its determination. V. VÄISÄLÄ. *Ann. Acad. Sci. Fennicae, Ser. A I* (*No.* 18) 60 *pp.* (1943) *In German.*

A general review of the entropy of air is made. The temperature 152·26°K at which the entropy of ice is 0, is used as the basis for normal temperature and the reasons given. Formulae, tables and a slide rule are developed for the determination of entropy. New curves, isentropics, are determined for the already existing adiabatics. New definitions are given for potential and isobaric temperature. It is proposed that the partial entropy of dry air and of water vapour should be used as invariants in mass analysis. R. S. READ

551.511 : 551.551

6896. The application of the similarity theory of turbulence to atmospheric diffusion. G. K. BATCHELOR. *Quart. J. Roy. Met. Soc.*, **76**, 133–46 (*April*, 1950).

The purpose of this paper is to draw the attention of meteorologists to the potential usefulness of the similarity theory of the small-scale structure of turbulent motion first put forward by Kolmogoroff. An outline of the theory is given first and the possibility of its application to atmospheric and oceanic turbulence is considered. As an example of its use, the theory is applied to the problem of the relative diffusion of neighbouring particles moving with the fluid, and predictions about the rate of increase of mean square distance between the particles are made. Some data obtained recently by Durst are compared with these predictions by Charnock, and similar observations made by Richardson and Stommel are considered herein. The empirical proportionality between the diffusion coefficient and the 4/3 power of the scale of observation, obtained many years ago by Richardson, is shown to be in general agreement with the theory. A.

551.513

6897. Flow of momentum and mass across the high-pressure belt of the earth's atmosphere. C. H. B. PRIESTLEY. Letter in *Nature, Lond.*, **165**, 855–6 (*May* 27, 1950).

551.513 : 533.6.011.

The aerodynamic drag of grassland. *See Ab* 6303

551.51

6898. Dynamics of thunderstorms. Review of present explanations for pressure changes in thund storms. I. S. MULL AND Y. P. RAO. *Indian J. M Geophys.*, **1**, 116–36 (*April*, 1950).

It has generally been believed that the pressure i is the only type of pressure change which can occ with the passage of a thunderstorm and that t rise is invariably accompanied with a fall in bulb temperature. Evidence has been brought fo to show that this is not always the case and that addition to instances of thunderstorms with press rise, there are also cases of thunderstorms acco panied by no pressure change or even a pressure f It is also observed that these pressure variations a not always associated with a temperature fall, t are in some cases also accompanied by a rise, or appreciable change, in dry bulb. A review of t present explanations of pressure changes in thund storms is given and it is shown how these are ina quate to explain all the observed facts.

551.515.4 : 551.594.

6899. Synoptic-aerological and atmospheric-electri analysis of a strange thunderstorm phenomen J. GROSS. *Geofis. Pura Appl.*, **16**, 19–37 (*Jan.–Marc* 1950) *In German.*

The manifestations are described of a thunderstor which produced a single violent lightning discha causing widespread damage. From the informati available the lightning flash is believed to have stru in 5 places. A detailed analysis is given of t meteorological conditions over N.W. Europe on t day in question, the prevalent conditions bei described as a cold-front with a thick layer of grou fog. With a purely speculative method of reasoni an explanation of the lightning flash is attempted. R. H. GOLL

551.515.4 : 621.396

6900. Radar measurements of the initial growth thunderstorm precipitation cells. G. R. HILST AN G. P. MACDOWELL. *Bull. Amer. Met. Soc.*, **31**, 95– (*March*, 1950).

Sequence photographs of the P.P.I. and R.H. radar presentations of a thunderstorm in the initi stages of precipitation are utilized for measurement of the vertical and horizontal growth and propagatio of the storm. Rapid vertical growth, after the firs precipitation cell was detected, and uniform horizonta growth are observed. A

551.52

6901. A general method and a simplified formula fo calculating effective radiation. O. LÖNNQVIST. *Ark Geofys.*, **1**, *Paper* 4, 79–115 (1950).

A method is developed of calculating the down ward radiation from the atmosphere, by dividing th atmosphere into 5 layers and by representing th infrared water-vapour spectrum in the form of absorption bands, to each of which is assigned mean value of the absorption coefficient. It is found that the values of effective upward radiation thu calculated can be expressed by a simple formula i

ms of the surface temperature, the mean lapse e and a function representing the distribution of ter vapour. Allowance can be made for the ect of carbon dioxide. There is evidence of good reement between observed and calculated values of e radiation. E. M. FOURNIER D'ALBE

551.521.3

02. New determination of the constants of ngström's radiation formula. H. M. BOLZ AND FALCKENBERG. *Z. Met.*, **3**, 97–100 (*April*, 1949) *In rman.*

Angström's formula for infrared atmospheric unter-radiation (G) is: $G = \sigma T^4(a - b \cdot 10^{-c\varepsilon})$, here ε is vapour pressure in mm. Variations of σT^4 with ε are shown, found by 8 investigators 916–48). Authors found $a = 0{\cdot}820$, $b = 0{\cdot}250$, $= 0{\cdot}126$; 70% of 1 332 measurements differed by % or less from this expression. The apparatus vibration pyranometer") is described; values given it are ~ 6% above those previously found, G creases with turbidity, especially with sea winds, id is high in stationary anticyclones.

METEOROLOGICAL ABSTRACTS

551.521.31

03. The absorption of solar radiation in the mosphere. K. WEGENER. *Met. Rdsch.*, **2**, 174–5 *May–June*, 1949) *In German.*

Author considers that the accepted formula for lculating solar constant from Abbott's "waterflow" id "waterstir" actinometers is incorrect.

METEOROLOGICAL ABSTRACTS

551.524.4

04. The dependence of air temperature on height the nocturnal inversion. K. BROCKS. *Met. Rdsch.*, 159–67 (*May–June*, 1949) *In German.*

The nocturnal thermal stratification in the lowest 00 m over low ground in central and western Europe studied. In the lowest 20 m it is represented by ∂z (°/100 m) $= az^b$, where a is 15–30°C and b is $-0{\cdot}8$ to -1. This lower inversion layer persists n clear nights from 1¾ hr. before sunset to 1¾ hr ter sunrise; it deepens during night but is most able soon after sunset. After midnight temperature lls more in upper than lower layers. Variation of ctual temperature with height is also represented y a power law (exponent less than 0·2). Causes are iscussed. METEOROLOGICAL ABSTRACTS

551.525.2

05. A note on nocturnal cooling. E. KNIGHTING. *uart. J. Roy. Met. Soc.*, **76**, 173–81 (*April*, 1950).

The published methods of calculating the minimum round temperature after a clear night accompanied y radiational cooling are examined and a more omprehensive calculation is given which takes into ccount the physical properties both of the air and f the underlying surface. Some recent experiental data are adduced to support the contention at both the ground and the air supply the heat lost y radiation. A.

551.576 : 532.61 : 541.182

06. Theoretical aspects of cloud drop distributions. . B. KRAUS AND B. SMITH. *Aust. J. Sci. Res. A*, **3**, 376–88 (*Sept.*, 1949).

A theoretical study indicates that the number and size of the drops formed in a cloud vary with the rate of cooling, the initial temperature, and the air pressure. The faster the cooling rate, the lower the initial temperature, and the lower the altitude, the greater is the number of drops and the smaller their size. The drop size spectrum also depends, to a large extent, on the number of available condensation nuclei. Furthermore, it tends to be widened by sedimentation and turbulence. A.

551.59 : 539.16

6907. On the natural radioactivity of the atmosphere. H. GARRIGUE. *C.R. Acad. Sci., Paris*, **230**, 1272–4 (*March* 27, 1950) *In French.*

551.593.9

6908. Researches on the emission of the negative bands of N_2 at twilight. M. DUFAY. *Ann. Geophys.*, **5** (*No.* 1) 2–24 (1949) *In French.*

Observations of the N_2^+ emissions at 3 914 Å and 4 278 Å indicate a range of altitude of the emitting layer ~ 90 km to 130 km. The band structure suggests optical resonance as the most likely mode of excitation. Day-to-day variation of intensity is pronounced, emission being enhanced at times of exceptional geomagnetic activity. D. R. BARBER

551.593.9

6909. Spectrum of the night sky in the near infrared. J. DUFAY. *Ann. Geophys.*, **5** (*No.* 3) 183–7 (1949) *In French.*

Prism spectrograms of twilight and night-sky radiations in the near infrared (7 500–9 000 Å), exhibit a continuum intersected by numerous telluric absorption bands, and by emission bands of unknown origin. Emission is found intense around 7 500 Å and 8 250 Å, agreeing with earlier observations (Grandmontagne, 1941). A table of principal radiations observed, approx. strengths, and wavelengths of max. intensity is included. D. R. BARBER

551.593.9

6910. Note on the spectrum of the airglow in the red region. C. T. ELVEY. *Astrophys. J.*, **111**, 432–3 (*March*, 1950).

551.593.9

6911. Identification of the 6 560 A emission in the spectrum of the night sky. A. B. MEINEL. *Astrophys. J.*, **111**, 433–4 (*March*, 1950).

551.593.9 : 525.75

6912. The spectrum of the night sky in yellow and red regions, from 5 800 to 6 900 Å. J. CABANNES, J. DUFAY AND M. DUFAY. *C.R. Acad. Sci., Paris*, **230**, 1233–6 (*March* 27, 1950) *In French.*

With the new Cogan spectrograph [see Abstr. 158 (1949)], numerous emission features have been observed, and attributed to the molecule OH. These occur in the spectral range, 5 800 Å to 6 600 Å, and form an extension of the rotational band system in the near infrared found by Meinel [*Publ. Astron. Soc. Pacific*, **60**, 373 (1948)]. The obsd. intensity distribution in the band system yields a rotational temp. between 150° and 250°K. D. R. BARBER

551.593.9 : 535.243

6913. Spectrophotometric researches on the light of the night sky in the visible region. III. J. DUFAY AND M-L. TCHENG. *Ann. Geophys.*, **3**, 282–305 (1947) *In French.*

101 observations of the ratio of intensities at 70°

and 20° Z.D. have been obtained during 1941–43 for the principal N–S radiations at 5 577 Å, 5 893 Å and 6 300 Å. Altitude estimates, computed on the hypothesis of a single, thin emitting layer, have been derived from these, taking into account O_3 absorption, molecular diffusion and light-scatter into the primary radiation. Results indicate provisional heights of 80 km for Na *D* light and 100 km and 180 km respectively for green and red auroral lines [see also Abstr. 5170 (1949)]. D. R. BARBER

551.593.9 : 535.331

6914. On the origin of the sodium *D*-lines during twilight. R. PENNDORF. Letter in *Phys. Rev.*, **78**, 66 (*April* 1, 1950).

A chemiluminescent process is proposed to account for the emission of the Na *D*-lines at twilight. The cycle necessary to promote a steady emission involves the following reactions—Primary: $Na + N_2O \rightarrow NaO + N_2 + 1{\cdot}32$ eV. Secondary: $NaO + Na_2 \rightarrow Na_2O + Na'(^2P) + 0{\cdot}84$ eV, $Na'(^2P) \rightarrow Na(^2S) + 5\,890$ Å, $Na_2O + h\nu (\leqslant 2\,031$ Å$) \rightarrow Na_2 + O$. N_2O is known to exist at a level of ~ 100 km; and the altitude range of 5 893 Å emission is correlated with the vertical distribution of this gas, and not with that of Na. Theory suggests that the variation of the *D*-line emission with time will be sensitive to the vertical distribution of O_3. This is borne out by the exptl. results of Vegard and Kvifte (1945).

D. R. BARBER

551.594 : 621.319

6915. Atmospheric electricity. W. F. HELWIG. *Texas J. Sci.*, **1**, 19–22 (*Dec.* 30, 1949).

Continuing earlier work [*Elect. Engng*, **67**, 38 (1948)] results are given of some friction tests on a cotton disc with a variety of metallic electrodes. The accumulated frictional potentials are plotted as a function of the velocity of movement. The mechanism of transfer of electric charges is briefly discussed and the reasoning is extended to a tentative explanation of the electrification of thunder clouds and of dust particles. R. H. GOLDE (R)

551.594.22

6916. Duration of lightning strokes and occurrence of multiple strokes. H. NORINDER. *Tellus*, **2**, 24 (*Feb.*, 1950).

It is shown that the total duration of lightn strokes, the occurrence of multiple strokes and time interval between them are partially influen when measurements are made on direct strokes to objects. By recording the radiated electromagn field of lightning discharges in antenna circuits w cathode ray-oscillographs at great distances from lightning paths it was possible to obtain extens data on the variation characteristics of lightni Special methods were developed in order to anal the lightning discharges with regard to the sequence multiple strokes and the slow moving after-variati A comparison of the discharge characteristics lightning in Sweden with corresponding results fr lower latitudes leads to the assumption that intensity of thunderstorms is greater in low latitu than in high latitudes.

551.594.5 : 621.396

6917. Radio echo reflections from the aur borealis. A. ASPINALL AND G. S. HAWKINS. *J. B Astr. Ass.*, **60**, 130–5 (*April*, 1950).

Two types of echo have been received from t aurora by apparatus designed for the detection meteor radiants on a frequency of 72 Mc/s. Co parison with visual observations indicate that diff echoes of approximate ranges 600–800 km a associated with auroral glows and arcs, while discre echoes with ranges 400–900 km are associated wi auroral rays. The electron densities for the rays c be estimated, a mean value of 9×10^5/cm³ bei obtained. Changes in apparent ranges of the echo are shown to be due to real motion of the reflecti points, in qualitative agreement with visual obse vations. M. W. OVENDE

551.594.6 : 550.3

6918. Microwave sky noise. A. E. COVINGTO *J. Geophys. Res.*, **55**, 33–7 (*March*, 1950).

Intense bursts of microwave radiation from t zenith as well as small fluctuations below and abo the general sky radiation have been associated wi certain geomagnetic disturbances.

BIOLOGY 57/59

591.1 : 534.321.9

Measurements of the ultrasonic cries of bats. *See Abstr.* 5640

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.84 : 530.145

6919. Ricco's law and the quanta-explanation of vision. M. A. BOUMAN AND H. A. VAN DER VELDEN. Letter in *J. Opt. Soc. Amer.*, **40**, 336 (*May*, 1950).

612.84 : 621.389

6920. Testing eye muscles. E. R. POWSNER AND K. S. LION. *Electronics*, **23**, 96–9 (*March*, 1950).

This test, which is important in studying the progress of diseases such as poliomyelitis and othe effects, is made possible by the fact that the eyeba is a polarized sphere. Accordingly, electrodes place on opposite temples receive a voltage depending upo the angular position of the eyeball and the 2n derivation of the position will be $\propto$ the muscula forces moving it. The electrodes are connected to d.c. amplifier of ~ 100 db gain and then to circuit whose outputs correspond to the 2nd derivation, th 1st derivation, or the direct function, depending upo whether two differentiators, one, or none are included The time constants of the 1st and 2nd differentiator are 0·01 and 0·001 sec respectively. One importan feature is the insertion of shunting capacitors acros both differentiator inputs, thereby reducing nois without affecting the waveform sensibly. Record taken on a patient while reading show, on the direct

tion trace, the jumps (saccades) of the eye as it erses the print and the corresponding pulses on velocity and acceleration curves.

H. G. M. SPRATT (R)

612.84 : 774.8

1. Binocular vision and stereoscopic reconstitu- . H. C. LANE. *Photogr. J.*, *B*, **90**, 2–8 (*Jan.–Feb.*, 0).

he very stringent limitations of orthoptic stereo- ic reconstitution of a subject by photography are sidered and stated. Recommendations are made for controls for scientific work by individual workers and new norms are suggested for general purpose stereoscopy for viewing by numbers of individuals with varying interocular widths. Reference is made to the displacement of the physical and optical centres of the human eye and its effect on "scanned perspective" which can be partially corrected by reducing the node/image distance in the viewing lens as compared with the node/image distance in the camera lens. A.

615.84 : 537.542 : 539.166.08

Automatic isodose recorder. *See Abstr.* 6727

TECHNICAL MATERIALS 66/67

669 : 548

2. Progress in metal physics. *London, Butter- ths Scientific Publications*; *New York, Interscience olishers* (1949) 401 *pp.*

n the first volume of an annual series of reviews following topics are discussed: (1) *Progress in the ory of alloys* (G. V. Raynor), including sections on ctron compounds, electron theory of alloys, alloys transition metals with Al, ternary equilibrium and tice spacings; (2) *Theory of dislocations* (A. H. ttrell), with sections on their static and dynamical perties, stresses surrounding dislocations and those uired to move them, the segregation of solute ms round a dislocation, slip band formation and application of the concept of dislocations to strain d precipitation hardening, ageing and annealing of rked metals and transient creep; (3) *Crystal undaries* (R. King and B. Chalmers), discussing ir origin, mechanical properties and effects, lting, and surface and chemical effects; (4) *Age rdening of metals* (G. C. Smith), discussing various oretical ideas, the precipitation, lattice distortion d knot theories, θ' phase formation, localized precipitation, Guinier–Preston zones and recent microstructural investigations; Duralumin is considered fully; (5) *Hardening response of steels* (E. H. Bucknall and W. Steven), with sections on the hardening in plain C and alloy steels, early measurements, the Jominy and other tests, continuous cooling, incomplete hardening and attempts to systematize test data; (6) *Preferred orientation in non-ferrous metals* (T. L. Richards), discussing methods of measurement, types of texture and anisotropy after plastic deformation; (7) *Diffusion of metals in metals* (A. D. Le Claire), including consideration of early and phenomenological theories applied to binary and higher systems, the derivation of ideal diffusion coefficient values and a discussion of experimental results. The book is profusely illustrated, contains mathematical discussions of a few selected topics, a large amount of experimental data and very long lists of references, and is accompanied by full author and subject indexes. In this, the first volume, much historical background is included in the articles, subsequent articles being intended to cover the more recent progress. E. P. WOHLFARTH

PHOTOGRAPHY 77

771.31 : 535.42 : 535.8

The pin-hole camera. *See Abstr.* 6422

771.351 : 535.241

923. The measurement of stray light in photo- aphic objectives. A. KRUIS AND O. MACEK. *angew. Phys.*, **2** (*No.* 3) 106–14 (1950) *In German.* The contrast in a photographic image is shown to pend upon the stray light introduced by the jective, and the relationship between the two is und for varying contrasts in the object. Three ethods of measuring the stray light coefficient are scussed and comparative figures given for a number lenses. By successive "blooming" of the surfaces a triplet lens, the stray light coefficient is shown to minish exponentially with the number of surfaces eated. Since this coefficient varies with the quality the surfaces, their polish, etc., and the perfection the coating, the reciprocal of the stray light efficient is suggested as a figure of merit of the lens. R. W. FISH

771.43 : 53.087.56

6924. A machine for rapidly processing photo- graphic trace recordings. G. I. P. LEVENSON. *J. Sci. Instrum.*, **27**, 170–1 (*June*, 1950).

The 35 mm photographic paper passes through a small trough of cold developer and is then brought into contact with a heated drum. The paper is exposed at the point where it meets the hot drum and the trace becomes visible within 1 sec. The paper leaves the drum in a dry condition in which it is sufficiently stable to be exposed in white light without need for immediate fixation. A.

771.534.56

6925. On the photographic reciprocity law failure and related effects. II. The low intensity sequence effect. E. KATZ. *J. Chem. Phys.*, **18**, 499–506 (*April*, 1950).

A quantitative theory of all details of the low intensity sequence effect is given on the basis of the following assumptions. A monatomic Ag speck is

unstable against thermal agitation, a diatomic speck is stable, but for development a speck of more than two atoms is required. The theory is based on that for low intensity failure as developed in paper I [see Abstr. 3648 (1950)]. A.

771.534.56

6926. Low intensity reciprocity-law failure in photographic exposure. II. Multiplet-quantum hits in a critical time period. J. H. WEBB. *J. Opt. Soc. Amer.*, **40**, 197–202 (*April*, 1950).

771.535

6927. The theory of the Sabattier effect. IV. Latent internal development. H. ARENS. *Z. wiss. Photogr.*, **45** (*No.* 1–3) 1–7 (1950) *In German.*

An intensification of the internal latent image is brought about by the action of a developer acting on the surface of the grains in a photographic emulsion. The effect was proved by showing that the bleaching effect of a weak Farmer's solution on the fixed-out latent image was much reduced by the previous action of the surface developer, using physical development to reveal the internal latent image. These tests were done on an emulsion which gave hardly any surface image. The effect described is considered to be of importance in the explanation of the Sabattier effect, the enlarged internal latent-image specks acting as trapping centres, competing for the electrons released by the second exposure. W. F. BERG

774.8 : 612.84

Binocular vision and stereoscopic reconstitution. *See Abstr.* 6921

778.3

6928. The contraction of nuclear emulsions. S. L. MARTIN. *Aust. J. Sci. Res. A*, **53**, 389–93 (*Sept.*, 1949).

A technique for measuring the fractional change in thickness which occurs when a nuclear emulsion is processed, is described. The method involves the registration in the emulsion of the tracks of α-particles from a radiothorium source and this permanent record can be used to follow any subsequent thickness variations. Some observations on Ilford C2 emulsions, 50 μ in thickness, have been made and these show considerable variations in thickness over a period of time. Tests indicated that some of the change is probably due to humidity variations. The application of this method to the monitoring of variations in k for emulsions, in which deuterons or other tracks have been registered, is described. A.

778.3

6929. The photographic plate as a measuring instrument in nuclear physics. E. SCHOPPER. *Phys.* (*No.* 3) 113–22 (1950) *In German.*

A review article. W. F. I

7

6930. Removal of unwanted electron tracks fro emulsion without loss of sensitivity. G. ALBO *C.R. Acad. Sci., Paris*, **230**, 1351–3 (*April* 3, 195 *French.*

Electron tracks in Ilford G5 emulsion are ficially faded in an atmosphere saturated at 50°C water vapour in from 3 to 4 days. J. G. WIL

778.3 : 537

6931. The photographic effect of medium protons. II. Measurements with Ilford Q-pla P. BRIX AND H. G. DEHMELT. *Z. Phys.*, **126** (*No.* 10 728–33 (1949) *In German.*

Previous work [see Abstr. 2114 (1950)] on effect of medium energy protons on photogra plates is continued with Ilford Q-plates of gelatine content. The proton energy range 5 to 17 keV. Absolute blackening curves w measured. By grain counts in regions of sm blackening it was determined that at 5 keV ab every 5th proton made a grain developable while 17 keV about every 2nd proton did so. The ene dependence of the bombardment yield for the sim process agreed well with the data obtained w nuclear physics plates using energetic particles.

G. O. BAI

778.3 : 537.534

[On the] stopping power of nuclear emulsions charged particles of low energy. *See Abstr.* 6556–

778.37 : 535.89 : 621.325

6932. A compact-source lamp for high-spe cinematography. E. J. G. BEESON. *Elect. Times*, 1 447–50 (*March* 23, 1950).

Describes the compact-source Hg discharge lam rated at 1 kW, which can be over-run up to 10 k for periods of a sec or so for the purpose of hig speed cinematography at 250 to 3 000 frames/s Cd is added to the Hg and this provides extra rad tion in the red; the over-loading also increases t continuum relative to the Hg lines. The lamp used on d.c. and in a deep Al reflector will gi 100 000 ft candles over a 12 in square at a distan of 4 ft. With fast film, 3 000 pictures per sec can taken at $f/2{\cdot}8$ when the illumination is 10 000 candles. [See also Abstr. 6673 (1949); [*Photogr. B*, **89**, 62–7 (*May–June*, 1949)].

J. W. T. WALSH (

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